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PROCEEDINGS

OF THE

ROYAL IRISH ACADEMY.

VOLUME IX.—~~PART IV~~.

DUBLIN:
PRINTED BY M. H. GILL,
PRINTER TO THE ACADEMY.
1870.

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VOLUME I.—PART I.

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

MONDAY, APRIL 11, 1864.

WILLIAM HENRY HARDINGE, Esq., in the Chair.

Alexander M'Donnell, Esq.; J. J. Lalor, Esq.; the Hon. Thomas D'Arcy M'Gee; and Sir Victor A. Brooke, Bart.; were elected members of the Academy.

The Secretary read the following paper, by ALEXANDER MACALISTER, L. R. C. S. I., Demonstrator of Anatomy, Royal College of Surgeons:—

ON THE ANATOMY OF THE OSTRICH (STRUTHIO CAMELUS).

THE science of comparative anatomy requires for its basis the records of the careful and minute dissections of at least the typical forms of the animal kingdom, in order that we may arrive at correct ideas regarding the proper homologies and relations of the various parts of which the animate frame is made up; and though the subject of this memoir has been examined very frequently, there does not exist, to my knowledge, a complete or accurate account of its structural peculiarities. M. Perrault has left on record the dissection of eight of these birds; but in his description many interesting facts regarding the visceral anatomy are not mentioned, and the muscular system is not at all described. During the past year the splendid pair of ostriches belonging to the Zoological Society of Dublin died—the female in June, 1863, from the constitutional disturbance consequent on a compound fracture of the metatarsal bone of the left leg; the male in January, 1864, from the effects of the severe and unexpected frost: both these animals have been dissected with great care, and many novel points of anatomical and physiological importance have been ascertained in their structure.*

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* The female ostrich was dissected in the Museum of the Royal Dublin Society, and the male ostrich in the dissecting rooms of Trinity College. I am indebted to Dr. Carte and to the Rev. Professor Haughton for the opportunities I had of assisting in their anatomical examination.

They were both full grown and in good condition, the male being rather taller and fatter than the female. The integument, when removed, does not present the remarkable series of cutaneous muscles seen in the Apteryx; but a large number of superficial veins are discernible passing around the roots of the feathers. The skin varies in thickness in several localities, but in general is strong and dense; on the neck it is tough and thin; on the breast and pubis it presents two callosities of considerable size, on which the animal was in the habit of resting; on the dorsal aspect the tegument is thick and strong, and clothing the metatarsal bones it presents a series of large flat scales. Beneath, on the sole of the foot, the surface of the skin presents a series of closely set bristle-like processes, invested with a hard horny epithelium; these are about one-fifth of an inch in length, and would seem to serve in facilitating the transit of the animal over the sandy soil of the desert.

Under the skin is a fatty superficial fascia of very great thickness in some situations; over the abdomen in the female this adipose layer was two and a half inches thick, diminishing in thickness over the thorax, and ceasing altogether downwards on the thigh. The integuments and fat are closely connected to the bone over the sternum, in the region of the callosity, where the fatty matter has a granular appearance, similar to that on the sole of the human foot. This fatty layer is permeated by many very large veins, some of which can be traced to the pulp of the feathers. A thin and distinct layer of fascia separates the adipose structure from the muscles underneath, which were three in number—external oblique, internal oblique, and transversalis. The former arises from the lower borders of the ribs, and from a fascia which extends upwards to the vertebral column, and backwards to the brim of the pelvis; the fibres pass downwards and inwards to the mesial line, into which they are inserted for its whole length. The internal oblique, underneath the last, arises from the borders of the pelvis and lumbar fascia, runs forwards and inwards to the same insertion. The transversalis commences by a strong flat aponeurosis from the spine and lower border of the last two ribs. This structure becomes fleshy for about two inches, and then forms an anterior tendon, which is inserted into the linea alba as far down as the symphysis pubis. The expanded tendons of these muscles attached to the spine form a strong lumbar fascia.

Beneath these muscles lies an enormous fatty cushion, an inch and a half in thickness, and highly vascular; Perrault describes this as intervening between the abdominal muscles, but in reality it lies posterior to them, and immediately over the peritoneum, which in our female bore the marks of inflammatory action, and exhibited extensive subjacent ecchymosis.

On the wall of the thorax are found two layers of intercostal muscles, separated by the intercostal vessels; the external run downwards and forwards, and cease at the spurs of the vertebral ribs; the internal pass in a contrary direction, and only extend for three inches behind the spur on the vertebral ribs. A series of triangular levatores costarum pass from these spurs to the ribs below, extending as far forward as the articulation between the sternal and vertebral ribs; these and the internal intercostals are in contact with the serous membrane lining the thoracico-abdominal cavity. The sternal ribs articulate with the vertebral by means of arthrodial surfaces, united by capsular fibres and a central inter-articular ligament. On laying open the abdominal wall we disclose the viscera. The stomach is continuous with the lower end of the œsophagus, which exhibits at its lowest point a gradual dilatation, with no distinct proventriculus: this organ is placed obliquely, so that the cardiac orifice is on a plane inferior to the pyloric. The whole organ is an elongated oval in shape, and is not constricted in the centre; the thickness of its walls varies considerably,—the cardiac extremity being thin and membranous, the pyloric an inch and a half thick, and made up of alternating laminæ of muscle and tendon: its epithelial lining is thick and soft, very loosely attached, except in the vicinity of the pyloric orifice, and much corrugated, the rugæ being small, and arranged lineally in the long axis of the organ at the cardia, but larger and more irregularly convoluted at the pyloric extremity. This membrane has a decidedly acid reaction with litmus paper. The succenturiate gland is dumbbell-shaped, one broad extremity being placed at the cardia, and the other towards the pylorus; it measures four inches at its widest part, two at its constriction, and twelve in length; its orifices are arranged quincuncially, twenty-five to the square inch, and each communicates with a racemose gland. The pyloric orifice is much smaller than the œsophageal, and is semicircular in shape, its straight border being formed inferiorly by the tendinous wall of the gizzard; the curve is formed of alternate firm ridges and grooves, the former six in number, the latter seven, and by this apparatus the passage of undigested materials is retarded; this orifice is situated anteriorly, and between two radiating tendinous laminæ. All the substances contained in the stomach were of a dark green colour, as also was its epithelial coat; its contents were vegetable matters and stones in large quantities—the latter were rounded and worn.

In the outer coat of the stomach of the female, and in contact with the gastric artery, a pin was found, enclosed in a cyst. The intestinal canal seems to vary much in length. Hunter records finding it 70 feet, while Perrault, in his eight, states that it varied from 50 to 42, 33, and even to 29 feet; in our female the intestine measured 42 feet, and in the male 44 feet. The duodenum commences at the pylorus, is about three feet long, and passes very nearly in the course described by Hunter, first downwards, then turning and folding on itself, then passing from left to right, then ascending till it crosses the spine above the ovaries in the female, and is retained in its place by piercing through the root of the mesentery; at first, about three inches from its beginning, it receives the hepatic duct, and three feet lower the pancreatic. From the situation where it escapes from traversing the root of the mesentery it is accompanied downwards on either side by a spiral-valved cæcum, which is enclosed in the same layer of peritoneum, and lies about an inch distance from the gut; about $2\frac{3}{4}$ feet below, these cæca unite with the intestine, and from thence the colon passes downward rather narrower than the upper intestine; its surface presents valvulæ conniventes like those in the small intestine of man, which are arranged alternately on each part of the intestine, and pass three-fourths round the tube, projecting half an inch inwards. These elongate the mucous surface over which the food passes. This portion of the intestine was filled with hard fæcal masses, containing whole corn and undigested food. The lowest part of the rectum passes from the right side downwards, and opens into the same side of the cloaca, inclining a little to the left; it projects into this sac for about half an inch, and is surrounded by a strong sphincter muscle embedded in its everted lip. The mucous membrane is longitudinally plicated, and the anus can be dilated to a considerable extent. The longitudinal fibres of the rectum are very distinctly marked, especially near its termination. The folds of peritoneum which enclose the intestine are three in number: first, a short process which holds the duodenum in its place; secondly, a mesentery, in which is enclosed the intestine and cæca; and, thirdly, the portion which surrounds the lower intestine; this latter extends across the spine obliquely from above, downwards, and to the right. In the second fold the mesenteric artery is traceable, and the lacteals, which pass upwards and backwards, and form a thoracic duct, which is seen to pass behind the venæ cavæ, and internal to the upper part of the right kidney, and to the right of the aorta; all these folds lie superior to the ovaries.

The cloaca in the female is a large sac, admitting readily the whole hand; from its left side passes the oviduct, which is a large dilatable tube, capable of receiving four fingers and exhibiting longitudinal plicæ on its mucous membrane; on the right side, and in a corresponding position, is a small cæcal depression, but no duct. To the right of this and posteriorly the rectum opens at the top of the cavity, and between this aperture and the oviduct the mucous membrane forms a large crescentic fold, its concavity looking downwards and backwards towards the external orifice; this appears to be capable of shutting off the rectum during the passage of an ovum, and *vice versâ*. Behind the rectum and oviduct, in a small posterior pouch, open the two ureters very obliquely, one on either side, about an inch and a half apart, each admitting the little finger at their opening, but diminishing rapidly as they ascend; they are separated by a strong median ridge.

Into the outer margin of the cloaca a strong levator cloacæ muscle is inserted, which passes down from the posterior part of the sacrum and from the ischiatic ramus. A strong sphincter, an inch in breadth, encircles the external opening. In the centre on the upper surface is a small pendent of cellular and erectile tissue, or clitoris, which displays a dorsal groove. The mucous membrane of the cloaca is arranged in longitudinal plates, so as to facilitate distention.

In the lower part of the abdominal cavity in the female existed about two dozen ova, each enclosed in a separate sac or calyx, and all attached by a common pedicle about two inches thick to the posterior wall of the abdomen; by this the vessels pass into the ova, and ramify on the surface in a pectiniform manner, forming a vascular zone or girdle, the stigma of the ova. One of these ovaria, that had emitted its egg a few days before the animal's death, appeared collapsed and dark coloured; the others were light and yellowish, and from the size of a pea to that of a large teacup. To the left side, and attached by a long distinct fold of peritoneum, in which are contained many arborescent vessels, lies the oviduct, beginning above by a bilobate, soft, gelatinous orifice in the peritoneal fold enveloping the ova, and descending and gradually widening into a large ovisac; the whole tube is 2¾ feet long and opens by a narrow but dilatable orifice into the cloaca below. The interior of the lowest part was very gritty in feel, from the particles of carbonate of lime secreted there for the formation of the shell. The lowest part of the ovisac has a strong, well-developed muscular coat, which diminishes and almost ceases at the upper part.

The kidneys are elongated, flattened, glandular masses, thirteen inches long, and an inch and a half wide, lying deeply seated, and extending from the posterior edge of the diaphragm to the anterior extremity of the pelvic cavity; they are brownish-red in colour, rough on the surface, and the left is divided into two lobes; each is bordered by a large vein, which passes up to join the cava, posterior to which the ureter arises, at the junction of the inferior and middle third, from a well-marked pelvis, into which open several infundibula, which can be traced back to calyces. The medullary matter is not arranged in pyramids, nor do its tubes converge to papillæ. The ureter passes down approaching the mesial line, is reddish-white in colour, and cylindrical in shape. The renal artery is a branch of the aorta, and enters posterior to the ureter. The kidney is enveloped in a fatty capsule, which is very dense in front, and binds it down in its place, separating it from the ovaries. The supra-renal capsule is at its upper part, flattish-oval in shape, three inches long, and deep orange in colour; its inner angle passes considerably farther back than its external, and its upper surface is in contact with the diaphragm. There is no distinction of cortical and medullary matter in its structure. Superior to the kidney, on the left side, lies the spleen, enclosed in a layer of peritoneum derived from the stomach, and elliptical in shape, narrower above than below, the long axis being directed downwards, forwards, and to the right side; it is three inches and a half in length by one in breadth; it is surrounded by a capsule of peritoneum, and by a proper fibrous coat underneath; it is supplied by a branch of the cæliac axis, and is made up of a soft, spongy, vascular tissue of a deep red colour.

The generative organs of the male consist of two testes, placed above and a little external to the kidneys, invested in a strong fibrous tunica albuginea, about three inches long and 1¾ inches in width; from the outer and back parts of these organs, the tubes pass to form a large epididymis, which is prolonged for three inches below the testis, and narrows into the reddish soft vas deferens, which runs down almost parallel to the ureter, and opens into the cloaca a little external and anterior to it; there is an elongated and pointed eminence, more than a quarter of an inch long, seen on the mucous membrane of the cloaca, and at the apex of it is the orifice of the vas; the opening of the ureter is much smaller in the male than what it is in the female. The two vasa deferentia open on either side of the groove in the intromittent organ, which commences by two firm fibrous crura attached to the pubis, then turns downwards and backwards; when retracted, this organ lies at the bottom of the cloaca, curved; it has two muscles inserted into it, one at either side, which would serve to compress its texture. The dorsal groove terminates at its apex, where the investing membrane is red, and covered with a large number of sentient papillæ. There are inserted into the cloaca a pair of long round muscles on either side, which do not appear in the female, and which are attached to the rami of the pubis. A very strong sphincter guards the orifice of the cloacal sac.

The pancreas is about ten inches long, and is included between the first two turns of the duodenum, and surrounded by peritoneum; in colour it is pink, and is very soft, loose, and granular in texture; from its centre passes the pancreatic duct, which commences in the gland by two branches, which unite before it passes from the gland substance; its duct opens into the second fold of duodenum, nearly three feet from the hepatic.

The liver consists of two nearly equal lobes, the right being prolonged a little lower down than the left; these lobes are separated above by the vena cava, which grooves the organ; a falciform ligament also exists on the upper surface. The right lobe in the female exhibited an extravasation, and the capsule was very easily separated. No gall bladder existed. A small quadrate lobe exists behind the notch for the apex of the heart, and still farther back the outline of a Spigelian lobe is visible, separated from the former by a short transverse fissure, to which the lesser omentum is attached, and behind which is a large oval opening or foramen of Winslow. Through the transverse fissure the vena porta from the intestines passes upwards, and to the right a small branch or lesser porta pierces the left lobe. In front and to the left emerges the duct, which begins by three small branches, and passes behind the duodenum to the right, opening, three inches below the stomach, into that intestine. The liver has two lateral ligaments, and many vessels ramify between the layers of the left.

The large abdominal veins commence in the pelvic cavity, and pass forwards, one on either side, along the kidneys, grooving them as far as the middle of these glands, and lying about an inch apart; in this situation they bend inwards and unite, and then separate almost immediately, so as to form the figure of X; they still border the kidney, and unite at the upper edge of these glands, where the left one, the larger, passes over and joins the right; the vessels previous to this union receive the external iliac veins, and the femorals, which are separated from the femoral arteries by the kidneys, the latter vessel lying posterior.

The cava ascends inclined a little to the right, comes in contact with the lower border of the liver, and passes in the sulcus between the two lobes, then receives the venæ cavæ hepaticæ, and ends above in the right auricle.

In the thoracic portion of the somatic cavity the heart is seen in the centre, contained in the pericardium, a conical sac, the apex of which is very acute, and is directed downwards, and surrounded by the liver, between the lobes of which it lies. This fibro-serous membrane is connected posteriorly to the diaphragm, but partially separated from it by the œsophagus : on laying it open, the heart is exposed, with the great vessels starting from it. On the surface of the organ are seen the two coronary arteries, one arising behind the infundibulum of the pulmonary artery, and passing first between the left auricle and ventricle, then between the two ventricles anteriorly; the other, arising from the aorta, opposite the right side of the pulmonary artery, and passing in the posterior auriculo-ventricular sulcus, supplies the back of the heart, anastomosing with the last at the apex.

The right auricle is a medium-sized cavity, with well-marked vertical musculi pectinati in its wall, and no appendix. The inter-auricular septum is thick, and separates the right from the smaller left auricle, which also presents strong perpendicular muscular bands on its wall, and is likewise devoid of an appendix. The two pulmonary veins unite and open into this cavity, on its posterior wall, by one common aperture, which is surrounded by a strong muscular band, which would be competent to close the orifice in a valvular manner. To the outer surface of the auricle several fatty masses are appended, like the appendices epiploicæ of the intestines.

The right ventricle is a three-sided pyramid in shape when distended, smooth inside except around its edge, where there are a series of muscular trabeculæ; its auricular orifice is oval, about 1½ inch in its long axis, and guarded by a strong muscular valve, 1½ line thick, situated to the right of the foramen, and extending for two-thirds around it; a strong muscular band unites this to the anterior wall of the cavity, and strengthens its attachment. Numerous foraminæ Thebesianæ exist on the inner surface of this cavity. The orifice of the pulmonary artery is about two inches from the right auriculo-ventricular opening, and is guarded by three semilunar valves with indistinct corpora Arantii, and having large sinuses of Valsalva behind them.

The left ventricle is strong, its wall being thirteen lines thick in several places, near the apex, however, it is extremely thin, in one spot only measuring two lines. The left auriculo-ventricular opening has a strong zona tendinosa and three membranous valves attached by cordæ tendineæ, but without distinct musculi papilares connected to them: carneæ columnæ are apparent near the apex of this cavity, but are not connected to the valves. The cordæ tendineæ are very numerous, and pass transversely outwards from the walls of the cavity to the valves, the curtains of which are situated right, left, and posterior; the first is the largest, and is placed half an inch from the auricular opening. The aortic orifice presents nothing peculiar, but is protected by three semilunar valves. Longitudinal rugæ were visible in the lining membrane of the aorta in the female ostrich, with patches of atheromatous deposit.

The aorta passes from its origin to the right side, and then curves backwards and to the left; this arch ascends for a very short distance, and about an inch above its origin from its convexity it gives off two arteriæ innominatæ, right and left, the latter being on a plane anterior to the former, and both lying on the trachea, in front of which and above the aorta lies a large round air cavity, about two inches and a half in diameter, lined by a smooth cellular membrane, invested with a layer of epithelium, and presenting no distinct opening into it. The right innominate artery is about two inches and a half in length, forming a curve concave to the right; it gives off the carotid and subclavian branches, the latter being small and passing outwards, the former ascending.

In connexion with the carotid artery is a large, brownish, glandular mass, about an inch in diameter, supplied by many arteries, and emitting a large number of veins: this and its fellow of the left side are the lateral lobes of the thyroid body without an isthmus. The left innominate is similar to the right in most respects. From the commencement of the subclavian a small cervical branch—the vertebral—passes upwards into the posterior portion of the neck. The pulmonary artery arises from the infundibulum of the right ventricle, is about two and a half inches long; and one inch and a half in diameter; it passes upwards, backwards, and to the left, and then divides into right and left branches. The trunk lies in front of the aorta, and its bifurcation corresponds to the front of the termination of the trachea. The right branch passes through the grasp of the arch of the aorta, is rather smaller than the left, runs downwards, backwards, and to the right side, lying above the right bronchus. The cardiac nerves of the right side run parallel to its upper border as far as the anterior part of the root of the aorta, where they end in forming the coronary plexuses to supply the muscular substance of the heart. The left pulmonary artery is larger, more anterior, and superior, than the right, but nothing of importance is discernible in its course. The great veins are three in number—two superior cavæ, and one inferior: the left superior cava is formed by the union of the jugular and subclavian veins with several smaller vessels from the thoracic parietes. This vessel lies posterior and external to the sterno-tracheal muscle, and internal to the furculum. The length of this vein before it is joined by the azygos is three inches, and this latter vessel unites with it just as it is passing into the pericardium, and an inch and a half from its entrance into the auricle. This vein runs downwards, backwards, and to the right side. The left vena azygos begins in the abdomen, at the upper border of the ovaries, passes over the diaphragm, and runs obliquely on the side of the pericardium, behind the left lobe of the liver, and terminates in the left superior cava. The right superior cava is double the size of the left, with which it corresponds in many points, its orifice being separated in the auricle from the inferior cava by a membranous valve, the great Eustachian, which guards the mouth of the latter: as this vessel is passing downwards, and to the left side, it receives the right vena azygos, a very small vessel, scarcely admitting an ordinary probe, which passes between the pleura and pericardium on the right side, and passes behind, and to the right of the auricle. The pulmonary veins are two in number, one on either side; the left is the longest, and is placed below the bronchus, and was in the female plugged up by a firm fibrinous coagulum. These vessels coalesce as they approach the auricle.

When these various organs are removed, a complex system of septa is exposed; of these there are five portions—one transverse, a fibrous structure, formed mainly of a fold of peritoneum, is placed across between the liver and the heart above, and the stomach and spleen below. This fold is attached anteriorly and inferiorly to the lower edge of the sternum, and it unites with the tendinous lamina of the transversalis; behind, this lamina is united to the diaphragm proper, which we shall describe subsequently. This portion is not, however, a complete septum. On removing the liver and heart, two large fibrous laminæ are exposed, covering the very large air sacs, which occupy a large part of the thoracic cavity; these laminæ send in four septa on either side, so as thus to subdivide the lateral portions of the cavity into four compartments; but the divisions are extremely loose and fibrous, so that each compartment freely communicates with its neighbour. In the centre of these compartments existed several peculiar oval bodies, like lymphatic glands in appearance, and in structure composed of an external rough, firm, fibro-cellular coating, with an internal yellowish-brown matter of sebaceous consistence. These were about an inch long, three-fourths broad, and one-fourth in thickness, and were arranged in a line on each side, connected to the septa by ten or twelve threads, radiating in all directions. Beneath these bodies and the air sacs, we find a true muscular diaphragm, composed of a flat tendinous central lamina, and two lateral fleshy portions, concave in front and below, convex above and behind; it is attached on either side by five fleshy slips to the five lower vertebral ribs along their margins; the fibres run backwards and inwards to the tendons, and some pass a little upwards, and are about 2½ inches in length. The kidney reaches to its lower border, and the spleen lies on its inferior and posterior surface. The œsophagus pierces it in front, and lies below it for a considerable distance; the two lower muscular fasciculi are separated from the upper by a large aperture, looking downwards, forwards, and outwards, which led to the air sac from the bronchial tube. Two other large openings exist, one on either side of the œsophageal orifice, which pass downwards and backwards; and above, and external to these, are two smaller holes, running in the same direction; the two lower slips of muscular fibres are broad and flat, and the upper are round and thick. The aorta passes through the lower border of this true diaphragmatic structure, and on either side of it passes down a tendinous slip or crus, to be attached to the sides of the bodies of the lumbar vertebræ.

The lungs are exposed on removing the diaphragm, and appear placed at the upper and back part of the cavity of the thorax, filling the spaces around the heads of the ribs; into these organs pass the bronchial tubes, one along the centre of each lung towards the base, the right being more transverse and more curved than the left. These tubes are membranous, and communicate with the air sacs by means of the openings in the diaphragm; all its branches come off in a regular series from its posterior surface, and the trunk ends below by communicating with a large air sac, which lies on either side of the back of the abdominal cavity; this latter is similar in structure to the thoracic series of air cavities. The branches of the bronchus appear pinkish, and seem muscular, and are arranged in a row of eight or nine large holes, with an alternate series of smaller holes externally; a double row exists on the right, but a single series on the left. The air sacs communicate with these bronchi. The lungs are separated from each other by the aorta, which passes down inclining to the right side, and pierces through the diaphragm opposite the lowest border of the last thoracic rib; a tendinous arch passes over it at this point, below which the cœliac axis arises. This trunk is about 1½ inch long, and gives off gastric, hepatic, and splenic branches; around it is arranged a sympathetic solar plexus, and from its root start the diaphragmatic arteries. The superior mesenteric artery arises an inch below and to the right of the last, and supplies the intestines. The femoral artery arises from the aorta, three inches below the superior mesenteric; it is a small trunk, runs outwards, and divides into a proper femoral and an external iliac, which passes along the brim of the pubis as far as the symphysis; below the origin of this vessel the aorta, or sacra media, continues downwards behind and between the kidneys, and immediately behind the vena cava, from which it is separated by a delicate fascia. A large sciatic branch passes off through the sciatic notch, and accompanies the sciatic nerve, becoming poplitæal behind the knee; still lower, a series of renal vessels arise on either side, and from the anterior aspect of the aorta the ovarian vessels of the female start. At the lower border of the kidney the aorta bifurcates; each lateral branch, about two inches lower down, again divides into two, which again split in a similar manner, so as to form a series of eight tertiary branches, which terminate, behind the cloaca, in the pad of the tail, for the nutrition of the plumes.

In the neighbourhood of the tail there exist the following muscles:—Levator coccygis, which arises from the lower part of the sacrum, about two inches in extent; the fibres pass downwards and backwards, forming a series of roundish muscular fasciculi, which are inserted by round tendons into the seven caudal vertebræ as far as the last. Between this pair of muscles are seven depressions, corresponding to the foramina in the vertebræ. Coccygæus arises from the side of the lower half of the coccygæal vertebræ, forms a triangular mass, running to be inserted into the pad of the tail. There is no sign of an oil gland in this locality. Depressor coccygis is a small muscle, passing from the bodies of the upper to the last caudal vertebræ.

The muscles of the back form a small and not very distinctly developed series. On raising the integument and fat, we bring into view the first or latissimus dorsi, which arises tendinous from the spines of the three or four upper dorsal vertebræ. The fibres run downwards and outwards, to be inserted into the inner edge of the upper third of the humerus and fascia of the wing.

Rhomboideus major, beneath this, arises from the fascia at the upper and back part of the thoracic wall, passes forward to be inserted into the blade of the scapula along its posterior border.

Rhomboideus minor is above the last, and has a tendinous origin from transverse process of the last cervical vertebra, from which it passes downwards, and is inserted into the scapula above the last named. Beneath these rhomboids exists a deeper muscle, also of a rhomboid shape, which is attached to the necks of the first and second ribs, and is inserted near the point of the blade of the scapula.

Serratus is a small, thin, square muscle, arising by an aponeurotic expansion from the lower edge of the upper ribs; the fibres pass downwards and backwards, and are inserted into the anterior border of the scapula, below the origin of the teres minor.

Semispinalis dorsi, or sacrolumbalis, arises from the upper border of the posterior portion of the crest and dorsum of the ilium, and from the sides of the lower vertebræ, by fleshy fibres, which pass forwards and a little outwards, to be inserted into the angles of the five upper ribs by tendinous and fleshy fasciculi. Lying internal to this we find the longissimus dorsi, attached below to the posterior and inner half of the crest of the ilium, and to the sides of the lumbar vertebræ; the muscle runs upwards and forwards, and at the lower part of the neck divides into several fasciculi, which run to be inserted into the sides of the transverse processes of the four lower cervical vertebræ: the most internal band continues upwards, to be attached to the five or six upper cervical transverse processes, and to a pit above the foramen magnum on the occipital bone. This muscle seems to consist of several portions which in other animals are distinct.

Levatores costarum posteriores, seven in number, arise tendinous and fleshy from the transverse process of the seven upper dorsal vertebræ, and run outwards and backwards, to be inserted into the outer surface of the ribs as far as the angle; their action is to elevate or fix the vertebral ribs. Spinalis dorsi passes from the lower to the upper dorsal spines, but seems not to be attached to any regular number of vertebræ.

Scalenus—a small triangular mass—arises from the posterior tubercle of the transverse process of the last cervical vertebra, and is inserted into the upper border of the first rib, close to its vertebral articulation.

Multifidus colli consist of many slips, which pass from the anterior tubercles of the transverse processes on the sides of the cervical vertebræ to be inserted into the prominent tubercle on the middle of the anterior aspect of the body of the vertebra above. There is also a posterior set of these muscles, which run from the posterior tubercle of the transverse process of each vertebra to the spinous process of the vertebra above.

A thin biventer cervicis may be found, arising by an aponeurosis from the dorsal vertebræ, and inserted along with the longissimus dorsi. On the front of the thorax, the great pectoral is seen—flat, thin, fleshy, and triangular—arising from the outer edge of the sternum and the three upper sternal ribs, and passing outwards to be inserted into the ridge on the upper and outer parts of the humerus below its head.

When the integument is removed from the face, a series of facial muscles are exposed, principally connected with the eye, which is guarded by two nearly equal lids, whose edges are beset with stiff, everted hairs, longer on the upper than on the lower lid. Transverse fibres run into the substance of the lower lid, like the remains of an orbicularis palpebrarum, the use of which seems to be, to elevate the lower lid; posterior and superficial to it is a venous plexus, formed of the veins of the head and face uniting to form a single trunk, which passes to the jugular vein. A strong palpebral ligament extends from the brim of the orbit all round into the lid, to strengthen it. Levator palpebræ superioris arises within the orbit, from the bony surface forming the posterior portion of the roof of the cavity; the fibres run outwards, and are inserted into the tarsal border of the lid. A small anterior bundle of muscular fibres passes from the inner or anterior angle of the orbit to the inner canthus of the lids; this seems to be also an elevator of the upper lid.

The orbit contains the recti, obliqui, and the two muscles of the membrana nictitans: the former arise around the border of the optic foramen, united by a ligament of Zinn, stronger above than below. The muscles of the membrana nictitans are, as usual, quadrate and triangular; nothing of peculiarity is noticeable in their arrangement, except that from their greater size they are better seen than in most birds. They are supplied by the third nerve, and the tendon of the triangular muscle grooves the sclerotic posterior to the bony plates. External to the triangular muscle, and between the inferior and internal rectus, is placed a large oval Harderian gland, embedded in cellular tissue, and compressed, probably by the triangular muscle when acting, so that its secretion is forced out, and is conveyed by a duct to the inferior and inner border of the attachment of the membrana nictitans. A peculiar gland is found embedded in the depression on the side of the frontal bone, separated from the nose by a strong membrane, through which its duct seems to penetrate. All the parts in the orbit are surrounded by the layers of a loose ocular fascia.

There are two elevators of the lower jaw, closely connected. Temporal arises from the deep fossa behind the orbit, and is inserted into the coronoid process of the lower jaw; the other lies more horizontally, and arises posterior to the last from the hinder portion of the temporal fossa, almost as far back as the occipital bone; from this origin it passes downwards and forwards, to be inserted into the ramus of the lower jaw in front of the coronoid process, here overlapping the last. A large glandular mass fills up part of the interspace between these muscles, in contact with the forementioned venous plexus.

In dissecting the neck, a large platysma is first seen, which below is attached to the furculum, and above to the integument, as high as the head; its outer fibres are oblique, and the inner vertical; it is thicker and stronger in front than behind; beneath it, at the upper part of the throat, is the larynx and its muscular apparatus, and in our dissection we meet with the following:—

Mylo-hyoid—flat and triangular—arising from a ridge on the anterior four-fifths of the lower maxilla, in contact with the mucous membrane of the mouth; the fibres pass inwards, and are inserted along with the opposite muscle into a median raphe; a few of the most posterior are attached to the os hyoides.

Maxillo-keratic is a long flat slip, passing from the lower jaw a little in front of its condyle, to be inserted into the concavity of the great cornu of the os hyoides, round which it winds. A small muscular slip runs from the great cornu of the os hyoides on one side to the opposite, probably acting as an approximator. Genio-hyoid—flat and straight—runs from the lower surface of the centre of the lower jaw, passing backwards to be inserted into the body and root of the great cornu of the os hyoides; beneath this pair is the upper quadrilateral projection of the os hyoides, continued into the very short tongue. Hyoglossus, a very short muscle, passes from the sides of the body of the os hyoides, as far forwards as to the tip of the tongue.

Numerous small muscular slips exist on the anterior aspect of the larynx: one—hyo-laryngeus—passes from the back of the os hyoides to the upper border of the thyroid cartilage, and several small transverse slips unite the cornua of the thyroid cartilage. Thyro-hyoid—small, transverse—passes from the oblique line on the front of the thyroid cartilage, to be inserted into the great cornu of the os hyoides. Sterno-tracheal—three feet and a half in length—arises from the posterior surface of the top of the sternum by a round muscular slip, which is reflected inwards on the side of the trachea, three inches above its bifurcation; from this point the muscle passes upwards, being adherent to the cartilaginous rings as it ascends, the fibres expand, and finally are inserted into the lower border of the thyroid cartilage, some passing as far as the os hyoides. On the side of the thyroid cartilage a small muscular slip passes to the back of the os hyoides. In the substance of the tongue a few longitudinal muscular fibres or linguales can be traced on either side of the middle line. The upper larynx exhibits two vocal cords, which are more than half cartilaginous. There is no epiglottis; the muscles seated here are principally the proper arytenoids and posterior dilator muscles; a pair of thyro-arytenoids may also be seen. There is no lower larynx. The trachea is made up of complete cartilaginous rings, forming a tube three feet nine inches in length, behind which lies the œsophagus, with a plicated lining membrane, which begins above in a dilatation or pharynx; on either side of the upper part of this sac lies a large glandular mass or tonsil, opening by several ducts, which communicate with racemose gland cavities. The jugular vein, which lies in front of the carotid artery, passes posterior and external to the œsophagus; the arteries lie close together, but do not communicate.

In removing the upper portion of the skull, in order to expose the brain, the bones are found extremely spongy, and united at the sutures. When they are removed, the encephalon is brought into view, invested with a dura mater, arachnoid, and pia mater. The former is strong, and does not present more than the rudiment of a falx; and the latter is found passing into the ventricles on either side, forming a choroid plexus. The cerebrum exhibits no convolutions on its surface, and is made up of two hemispheres and two tubercles or optic lobes. The cerebellum lies posterior and inferior to the cerebrum; and the medulla oblongata is a central prominence, exhibiting no secondary subdivisions, connecting the spinal marrow below with the encephalon above. The cerebellum consists of one large central lobe, marked out into a series of transverse lamellæ by fissures or involutions; to either side of it small lateral lobes are appended, and in section it presents a distinct *Arbor vitæ*. No pons varolii seems to exist even in rudiment. The carotid arteries ramify on the surface of the organ, and the vertebrals pass on the side of the medulla oblongata. From the base of the brain pass the cerebral nerves. The first, or olfactory, runs to the nose, under a bony shelf, from the anterior and inferior portion of the cerebrum, where a small conical eminence is observable; it is extremely soft and somewhat greyish at its origin. The second, or optic, arises from the optic lobes, curves downwards and forwards, and meets in front of the infundibular fold of pia mater with its fellow of the opposite side; the decussating fibres are easily seen at the commissure. The third and fourth nerves pass to the orbit, where they supply the muscles; they arise between the medulla oblongata and the posterior cerebral tubercles. The trifacial nerve is very small, and has an extremely small supra-orbital branch. The eighth pair sends off a large glosso-pharyngeal to the tongue, along with a glossal branch of the pneumogastric. None of the other nerves display any points of interest.

On removing the upper part of one of the cerebral hemispheres, the large lateral ventricle is exhibited, closed internally from the median fissure by a thin plate, white on the ventricular, and grey on the internal aspect. This plate is connected with the opposite side by a narrow white band, easily torn, and situated far back, not far from the posterior cerebral tubercles; this seems to be similar to the band described by A. Müller as a rudimental corpus callosum. Each lateral ventricle consists of one part, and presents no cornua; it has two large grey masses on its floor—one large, anterior, the corpus striatum; another smaller, posterior, the optic thalamus, separated by a rudimentary tænia; overlapping the thalamus is a large fold of pia mater, which gains entrance posteriorly; this is the choroid plexus.

Posterior to the cerebral hemispheres appear the optic lobes or tubercles, which are covered by a layer of pia mater, enclosing a small oval pineal gland; these tubercles are hollow, and their cavities communicate with the lateral ventricles; in front of them passes a posterior commissure, which overlaps a large iter ad quartum ventriculum, or Sylvian aqueduct. The fourth ventricle is placed anterior and inferior to the cerebellum, and presents a very well marked calamus scriptorius. The spinal cord is fissured deeply in front and behind, and is enveloped in three membranes; each spinal nerve arises by two roots, of which the anterior is much the smaller; these pass separately through the dura mater, and unite outside the foramina of conjugation of the vertebræ, the posterior forming a ganglion which the anterior crosses, and the two roots are united immediately external; a branch of the sympathetic can be traced to each ganglion. The roots of the spinal nerves are not separated by a ligamentum denticulatum, but pass obliquely downward and outward, converging. The sympathetic is a small cord, passing along the spine, behind the aorta, and forming a solar plexus around the cœliac axis.

The dissection of the extremities, both anterior and posterior, presents very many points of importance. Of late years, from the many interesting questions arising out of the subject of the origin of species, it has become a point of extreme importance that comparisons should be instituted between the development of similar structures in different animals, or diverse parts of the same animal, in order that we may arrive at correct ideas of homology. Now, in the ostrich we have a bird with terrestrial habits, and bearing a resemblance in the arrangements of its muscles to the mammalian class of animals; consequently it is of immense importance to have a correct idea of the position and nature of the muscles in his limbs. The branch of comparative anatomy which treats of muscles has been very much neglected of late, although there are as interesting considerations and as difficult problems involved in myology as in neurology or osteology.

The upper extremity, or wing, in the ostrich is very small, and perfectly incapable of flight; the prolonged humerus forms a very large portion of it. We find in this limb, however, the homologues of most of those muscles which are of use in those birds which are fitted for aërial locomotion. Coraco-brachialis forms an elongated fleshy muscle, arising from the outer third of the inferior edge of the coracoid bone, about two inches from its sternal articulation, it passes downwards and backwards, to be inserted into an oblique line on the inner side of the humerus, running downwards as far as about four inches below the head.

Biceps—a long, thin band—arises, by a distinct round tendon, from the coracoid bone, above the coraco-brachialis, and also by a distinct slip from that muscle. The fibres pass down straight, and are inserted by a tendon, which runs on the surface of the muscle for a short distance, into the tubercle on the inner side of the radius. This muscle is covered by a large cephalic vein, which runs from the outer side of the fore-arm to the inner side of the axilla, and terminates in the axillary vein.

Covering the outer surface of the foramen which exists between the coracoid and clavicular apophyses, is a triangular fleshy mass, with its base inwards. This muscle Professor Haughton has suggested, and apparently with good reason, to be the second pectoral of birds. Its fibres arise from the borders of this aperture, which it blocks up, and run outwards, becoming tendinous. The tendon passes in a groove over the head of the humerus, winding round a trochlear surface, to be inserted into the outer part of the great tuberosity. The function performed by this muscle evidently seems to be the elevation of the wing.

A hurried glance at the combined coracoid bone and clavicle cannot fail to suggest to the mind the appearance of the anterior part of an os innominatum, of which the former represents the ischiatic segment, and the latter, the pubis. The resemblance is extremely striking between the obturator foramen and this aperture in the bones of the scapular arch. May we not, then, consider the muscle closing this as the homotype of the obturator, in the anterior extremity, and thus conclude that the second pectoral in the fore is homotypical with the obturator externus in the hinder limb?

The subscapular muscle is divided into two portions: a superior, small, triangular, passes from the thoracic aspect of the coracoid bone, and upper part of the scapula, to be inserted into the inner tubercle, at the upper extremity of the humerus. The inferior portion arises from the posterior border of the scapula; the fibres run outwards, to be inserted by a twisted tendon below the last.

Deltoid—a triangular muscle—arises from the posterior border of the scapula, behind the humeral joint, by a flat tendon; it passes downwards and outwards, becoming fleshy, and is inserted into the ridge on the back of the humerus, as far down as to within three inches of the humero-cubital articulation.

Teres minor passes from the border of the blade of the scapula to the lowest point of the tubercle of the humerus. Extensor cubiti consists of two heads—one long, arising from the lower border of the scapula, between teres and deltoid; the second, or inner, from a ridge on the inner side of the humerus, as far down as an inch from the cubital joint; the two heads unite low down, and clothe the back of the humerus, and are inserted into the olecranon process of the ulna and fascia. Brachialis anticus arises from the lower half of the anterior surface of the humerus, passes under the pronator teres, to be inserted into an oblique ridge on the front of the ulna. Pronator teres runs from the internal condyle to the outer side of the radius, and passes over the radial artery.

Flexor digitorum communis arises from the anterior surface of the ulna, as far down as the lower extremity of that bone. The fibres end in small tendons, which are inserted into the second phalanx of all the digits.

Flexor carpi ulnaris passes from the inner condyle of the humerus, and the external part of the ulna, to the pisiform bone of the carpus. Supinator longus arises from a ridge above the outer condyle, and is inserted into the metacarpal bone of the thumb. The musculo-spiral nerve runs between this muscle and the brachialis anticus. Supinator brevis, beneath the last, runs from the outer condyle and external lateral ligament, to be inserted into the upper and outer part of the radius.

Extensor carpi radialis arises from the posterior surface of the radius, and runs to be inserted into the outer metacarpal bone.

Extensor digitorum communis passes from the external condyle into the last phalanges of the inner digits.

Extensor carpi ulnaris arises from the back of the outer condyle, and from the posterior surface of the ulna, for its whole length, and is inserted into the base of the outer metacarpal bone.

Indicator passes from the interosseous space, and the side of the ulna, and ends in a tendon which passes to the index finger. There are two interossei on the front of the metacarpal bones, and one on the dorsal aspect. A small abductor minimi digiti runs from the pisiform bone to the metacarpal bone of the third finger; and a still smaller abductor pollicis is attached to the outer bones of the carpus, and inserted into the first phalanx. The small subclavian artery, about the size of a crow-quill, runs between the clavicle and first rib, and so passes down to nourish the upper extremity.

But, as the great characteristic endowment of the ostrich is its enormous power of running, we find that the muscles of its hinder limbs are those which are pre-eminent in point of development; these are exposed when the integument and the subjacent strong fascia are raised. Under the skin in the thigh, two large veins, an external, and an internal saphena, are traceable. Covering the whole of the posterior part of the hip and thigh, an enormous, triangular, flat, fleshy muscle is brought into view, which seems to consist of three parts—the upper third, or tensor vaginæ femoris, the middle, or glutæus maximus; the inferior, or the depressor caudæ; the whole mass arises from the posterior edge of the ilium as far forwards as the commencement of the symphysis iliaca, and as far backwards as the side of the tail. The tensor vaginæ femoris runs forwards, downwards, and outwards, converging to form a flat tendon, which passes over the anterior and external surface of the knee, where it unites with the anterior and lateral heads of the gastrocnemius, and partly is inserted into the head of the tibia along its anterior edge; the middle third, or glutæus, is inserted along with the last, and by a small musculo-tendinous slip unites with the vastus externus beneath. The depressor caudæ is hardly separable from the posterior border of the glutæus maximus, and is inserted into the lowest border of the tendons of the two upper portions.

On removing this enormous covering, the deeper muscles are exposed. Sartorius—a square, thick mass—arises from the outer side of the upper and anterior part of the ilium, and from the spines of the lumbar vertebræ; the fibres run downwards, forwards, and outwards, to be inserted into the side of the ligamentum patellæ, and the upper portion of the inner condyle of the tibia, and by a fascial expansion to the inner condyle of the femur. Glutæus medius—a triangular fan-shaped muscle—arising from a large space on the ilium, almost the whole of its external surface as far back as the acetabulum; the fibres converge, and run outwards to form a flat tendon, which is inserted into a pit on the upper and outer part of the great trochanter. The tendon passes over a bursa on the summit of the trochanter, and is attached to the origin of the vastus externus. The tendon of this muscle commences between two planes of muscular fibre. Glutæus minimus is a small pear-shaped muscle, arising from the upper and anterior portion of the ilium, superior and anterior to the acetabulum; its fibres converge, run backwards and outwards, and are inserted into the anterior ridge at the root of the great trochanter, posterior and inferior to the glutæus medius, and beneath a tendinous arch, formed by the origin of the vastus externus.

Opponens quadrato-femoris, or ilio-capsular, is a remarkable, well-marked, triangular, fleshy slip, arising from the ilium, anterior and inferior to glutæus medius, and superior and anterior to the glutæus minimus; the fibres run outwards, to be inserted into the same line as the last named muscle, and are united to it by a tendinous slip. The nature of the homology of this muscle does not appear at first sight very distinct; but it seems to agree with the muscle described by Harrison as the ilio-capsular, which rarely though occasionally occurs in man; and Dr. Wilson has suggested to me that it may be the homotype in the hinder limb of the supraspinatus in the upper extremity.

The glutæal artery, nerve, and vein, separate it from the glutæus minimus, and pass directly backwards to supply the muscles of the hip.

Iliacus is a triangular muscle, arising from the part of the iliac bone directly under the glutæus medius, and between the glutæus minimus and opponens muscles; it passes downwards and outwards to be inserted into the lower part of the neck of the femur and lesser trochanter, under the cruræus. The sciatic artery passes along with the sciatic nerve downwards to form the poplitæal, as the femoral artery is small, and only supplies the front of the thigh. The femoral vein and artery are separated by the crural nerve. Cruræus—a large oval muscle—arises tendinous and fleshy from the point of the great trochanter, and from the lower two-thirds of the anterior surface of the shaft of the femur; the fibres run forwards, and are inserted fleshy into the upper border of the patella on the inner side, and by a tendinous expansion into the anterior edge of the head of the tibia. Vastus internus muscle is composed of two parts, a superficial and a deeper seated; the former arises from the posterior and internal side of the femur, and from the linea aspera as far as to within two inches of the condyle; the second portion arises from the anterior and inner side of the bone, and is distinct from the former part, which overlaps it; the fibres of both muscles unite below to form a twisted tendon, which is inserted into the inner side of the head of the tibia, into the inner edge of the patella and the ligamentum patellæ.

Vastus externus is likewise divisible into two planes of fibres: the superficial, strong, oval, fleshy and tendinous, arises from the outer surface of the great trochanter, and from the upper part of the external division of the linea aspera and the rough surface at the upper and outer part of the femur for two inches and a half from the point of the trochanter; the fibres pass downwards and forwards to form a flat tendon which is inserted into the capsule of the knee, into the upper border of the patella, and by a tendinous expansion into the external side of the tubercle of the tibia; this tendon is connected to the origin of the gastrocnemius, and overlaps the tendons of the glutæus medius and minimus. The deeper plane of fibres arise from the ridge on the external surface of the femur, and forms a fan-shaped tendon, which is best developed along the posterior edge; a flat tendinous band passes from its deep surface to the outer edge of the tubercle of the tibia, running downwards, backwards, and outwards, along with the external lateral ligament, and connected to the outer origins of the flexor muscles; the rest of it is inserted, with the superficial part of the vastus, into the patella and tubercle of the tibia.

Rectus femoris arises fleshy from the anterior spine on the iliac bone, three inches in front of the acetabulum; it forms a strong oval belly, which ends in a flat tendon, which soon becomes rounded, and passes over the anterior surface of the patella in a deep groove, which is directed downwards and outwards, underneath the outer head of the gastrocnemius; it then passes underneath the vastus externus and biceps tendons, becomes fleshy, and forms one of the origins of the flexor digitorum magnus: the length of this whole muscle, with its lower belly, is five feet.

On the back of the thigh are arranged the following muscles :—

Biceps—a large fleshy muscle—arises from all that part of the prolonged inferior spine of the ilium as far forward as the acetabulum, and separated from the inferior edge of the bone by the origin of the semimembranosus. In the female a small slip existed, attaching it to the posterior surface of the femur, which did not appear in the male. The fibres converge to a strong round tendon, which passes through a pulley, formed by the outer head of the gastrocnemius, and lined by a synovial membrane, and is inserted into the tubercle on the middle of the fibula: this muscle forms the external boundary of the poplitæal space.

Semitendinosus—long, flat, and triangular—arises by two fleshy slips from the extremity of the posterior inferior spine of the ilium, and from the tuber ischii and the great sciatic ligament; the fibres converge, and are inserted into the upper and back part of the inner side of the tibia and tibial fascia; an accessory muscular slip connects this tendon with the insertion of the adductor magnus and the shaft of the femur.

Semimembranosus arises from the inferior border of the posterior inferior spine of the ilium, and from the border of the great sciatic ligament; the fibres are inserted into the lesser trochanter of the femur, and into a fascial line as far as the inner condyle. A slip from its origin in the female was attached to the side of the caudal vertebræ.

On the inner side of the thigh are arranged the following muscles :—

Obturator—a large, ovoidal, tendinous, and fleshy mass—arises from both the inner and outer surface of the rami of the pubis and ischium; communicating through the obturator foramen; all the fibres pass in the direction of the long axis of the pelvis, converging towards the lesser sciatic notch, which is almost entirely osseous, and is placed at the junction of the ischium and ilium; here it becomes tendinous, and passes outwards and a little backward to be inserted into the outer and upper part of the great trochanter. Its action is determined from the trochlear surface of the notch or foramen over which it winds, which is invested with synovial membrane; within the pelvis it lies along the border of the kidney.

Gemellus superior—flattish, small—arises from the anterior edge of the lesser sciatic notch, and is inserted by a thin flat tendon into the great trochanter in front of the obturator.

Gemellus inferior—smaller than the last—passes from the hinder margin of the lesser sciatic notch to the trochanter, behind the obturator tendon. These three muscles run in contact with the synovial membrane of the hip, as the capsule is very imperfect beneath.

Pectineus—a small flattish muscle—arises fleshy from the upper fifth of the ramus of the pubis, and from the pectineal eminence; the fibres run forwards, downwards, and outwards, becoming tendinous, to be inserted into the external part of the upper extremity of the tibia, immediately below the knee.

Gracilis arises by a flat tendon, about five inches long, from the ramus of the ischium and sciatic ligament; the fibres converge, and are inserted below the knee into the inner edge of the tibia, below the condyle, and into the fascia of the leg.

Adductor magnus arises fleshy from the posterior border of the ramus of the ischium, internal to the origin of the semitendinosus. The fibres pass downwards, forwards, and inwards, to be inserted into the upper part of the condyloid pit of the femur.

Gastrocnemius—an enormously large fleshy mass, investing the back, front, and sides of the leg—arises by four heads: one from the external side of the patella and ligamentum patellæ, as far down as the tubercle of the tibia; the second springs from the external condyle of the femur and external lateral ligament; a tendinous pulley passes across from the upper part of the outer condyle, looping round to the external head, and around this winds the biceps; the third head is attached to the deep pit over the internal condyle; and the fourth, or external or largest head, arises from the anterior and lateral aspects of the tubercle of the tibia, the ligamentum patellæ, and both patellæ, also from the fibula by fascia, for its whole length. All these masses unite, and end in a large flat strong tendon, nearly two inches wide, which is inserted into the edges of the metatarsal bone as far down as its lower third; this tendon winds over the trochlear surface at the end of the tibia, forming a sheath for the deeper tendons on the back of the metatarsus.

Tibialis anticus—long and thick—arises by two heads: one internal fleshy, from the outer surface of the groove on the outside of the tubercle of the tibia; the outer by a very strong round tendon from the articular surface of the outer condyle; this soon becomes fleshy, three inches below its origin, and unites with the former. The tendon passes to the ankle under a distinct annular ligament, and splits into two parts for the passage of the extensor ungualis, each part being inserted into the lateral ridges on the anterior aspect of the metatarsal bone. The deep origin of this muscle is sheathed by the synovial membrane of the knee joint, which it strengthens very considerably. The anterior tibial vessels and nerves pass through the same sheath of the annular ligament, and the anterior tibial nerve passes through the splitting of the tendon.

Extensor digitorum communis arises fleshy from the sharp ridge of the anterior aspect of the tibia to five inches below the tubercle, and from the bony surface external to it; the fibres run to a strong round tendon, which passes in front of the ankle, internal to the last, and separated from it by a strong second annular ligament which binds it down; the tendon passes downwards, and ends in a flat expansion, which, at the metatarso-phalangeal joint, sends a slip into the proximal extremity of each of the phalanges.

Extensor unguis—a very delicate muscle—commences by a thin round tendon at the front of the trochlea, at the lower extremity of the tibia, close to the internal malleolus; this tendon passes through the insertion of the tibialis anticus, and ends in an extremely fine muscle, lying in a groove in front of the tibia; this belly ends in a tendon seventeen inches long, which passes under the extensor of the outer toe along the tendon of the last named, to be inserted into the last phalanx of the inner toe. The action of extension or elevation of the last phalanx and nail is facilitated by the prolongation upwards of the synovial membrane on the dorsum of the third phalanx.

Flexor digiti interni, arises by two heads—one from the outside of the tubercle of the tibia, the other from the external lateral ligament of the knee, separated from each other by the rectus tendon; these unite, and end in a tendon which passes in a groove in the sheath behind the tibio-metatarsal joint, and is inserted by two slips into the base of the third phalanx of the inner toe; the deep flexor perforates its last portion, and the superficial flexor is perforated by it; a sesamoid bone exists in the back of the metatarso-phalangeal joint, to which the retinacula are attached.

Flexor digitum magnus begins also by two heads—the upper, fleshy, from a deep pit above the condyles of the femur, in common with several other muscles; the lower from the tendon of the rectus, and external lateral ligament, and from the back of the fibula; these heads unite to form two fleshy bellies, detached above, but united below and behind the ankle by the junction of their tendons, which pass in the sheath behind the joint, and here the united tendons are perforated by the flexor externi digiti tendon. In passing down to the foot, the flexor digitorum tendon receives a slip from that of the gastrocnemius, at the metatarso-phalangeal joint, and sends a slip into the sesamoid tubercle of the former tendon; the tendon forms a sheath on the plantar surface of the toe, and is inserted into the base of the second phalanx by two slips.

Flexor profundus digitorum is the deepest tendon in the foot; it commences by two distinct fleshy masses—one from the pit in the back of the condyle of the femur, and the other from the posterior aspect of the tibia for its upper two-thirds; the tendons of the two are separate as far as near the metatarso-phalangeal joint, where they unite, and are inserted into the last phalanx of the great toe, and by a fine slip into the last phalanx of the outer toe.

Flexor perforatus externi digiti arises by two heads—one from the pit in the back of the femur by a common muscular origin; and the second from the external lateral ligament of the knee; the tendon passes down the common groove behind the metatarso-phalangeal joint, where it ends by three slips—one into the proximal phalanx of the lower toe; the two others are separated by the slip of the flexor profundus; and the outer is inserted into the base of the second phalanx, in common with the forementioned extensor slip of the little toe; the third passes to the base of the third phalanx.

Interosseus—an extremely delicate muscle—arises from the whole length of the interosseus groove, the two heads being separated at their origin by the interosseus artery piercing the bone; the tendon is flat and ribbonlike, and passes over the spur on the outer condyle of the metatarsus, and is inserted into the outer side of the base of the first phalanx of the outer toe; a few oblique fibres on the opposite side of the bone represent the dorsal interosseus muscle.

Poplitæus—a small, triangular muscle, having the base at the tibia, and the apex upwards and outwards—arises tendinous from the head of the fibula; the fibres pass downwards and inwards, to be inserted into the upper part of the tibia, as far as the internal lateral ligament. The poplitæal vein separates it from the back of the fibula, and the artery and nerve lie superficial.

The articulations of the lower extremity present many points of mechanical importance. The first, or the hip, is an enarthrosis, surrounded by a capsule, loose, expanding inferiorly; the synovial membrane spreads over the great trochanter; a strong transverse band passes from the border of the lesser sciatic notch to the upper and posterior edge of the acetabulum, under which the articular vessels pass to the joint. An extremely strong ligamentum teres passes downwards, outwards, and forwards, from the lower border of the cotyloid cavity, and is inserted into the upper part of a depression on the head of the femur, near which it is cylindrical; at its origin it is flattish and expanded; a cotyloid ligament protects the superior and anterior edge of the joint; thick and cartilaginous above, thin and membranous below and in front. The bottom of the cavity is separated from the air cells by a membrane consisting of fibres running downwards and forwards, and some radiating.

The knee is a ginglymus, formed by the femur, patella, tibia, and fibula.

The ligaments are: internal lateral, coffin-shaped, from the inner condyle, running downwards and backwards to the inner side of the popliteus. The most posterior fibres arise entirely from the internal semilunar cartilage, which they assist in fixing. The patella is large, flattish, made of two parts, the external surface larger, the inner smaller and more cartilaginous; the quadriceps is inserted into its upper border, and from its lower edge passes off on its inner side a large flat ligament, whose fibres, stretched over the Haversian masses of fat, converge, to be inserted into the upper edge of the tibia on the inner edge of the tubercle.

From the lower border of the true patella to the upper surface of the tubercle of the tibia extends a long, prismatic, bony column, united above to the patella by strong fibres, and resting below on the tubercle, with which it articulates by a strong ligament and a small synovial membrane. This seems to be properly an ossified ligamentum patellæ rather than a true second patella.

On the outer side of the joint there is a superficial ligament, which forms an origin for the long flexor muscles, and is attached above to the front of the outer condyle of the femur, and below is united to the origin of the before-named muscles. Some parts of it are inserted into the semilunar cartilage, and others pass downward, and slightly backward, to be inserted into a ridge on the side of the fibula. Beneath this a deeper ligament runs from the posterior portion of the outer condyle, downwards and backwards, to the anterior aspect of the head of the fibula; and the most anterior fibres are attached to the external semilunar cartilage. A synovial ligament, composed of synovial membrane, and containing a few blood-vessels, runs from the Haversian mass of fat to the front of the intercondyloid notch of the femur. Alar ligaments are two thin folds of the same structure, which lie on either side of the patella, and are inserted into the upper part of the middle ridge on that bone. Their free borders are directed inwards, towards the mesial line of the joint. The outer is much less distinct than the inner. The anterior crucial ligament arises from the inner side of the outer condyle, far back. It passes downwards, forwards, and inwards; and is inserted by two slips into the anterior cornu of the internal semilunar cartilage, and into the inner and anterior border of the internal condyle of the tibia. The posterior crucial runs from the posterior and superior part of the deep pit between the condyles of the femur, downwards and forwards, to be inserted into the spine of the tibia on the outer side of the posterior cornu of the internal semicircular cartilage, sending a small slip into the inner edge of the outer cartilage. There are two of these latter bodies—one semilunar, internal, with a thick outer rim, attached by its anterior cornu to the head of the tibia and transverse ligament, and by its posterior to the back of the spine of the tibia, and by a strong slip that passes behind the posterior crucial into the inner surface of the outer condyle of the femur. The external is larger, and forms a complete deep cup for the outer condyle. Its lower surface is irregular, to suit the upper part of the tibia and fibula, especially in front; it is connected to the internal by a broad and flat transverse ligament in front of the anterior crucial, and behind the Haversian mass of fat. Beneath the transverse ligament lies another broad flat band, from the front of the internal condyle of the tibia to the lower surface of the external semilunar cartilage. This body is connected to the anterior edge of the fibula by two small flat bands, one above the other, the lower being the larger, and both running backwards and outwards; behind, it is connected to the posterior edge of the head of the fibula by a small transverse slip.

The superior tibio-peronæal ligament passes from the outer and anterior part of the head of the tibia to the inner aspect of the head of the fibula, underneath the outer semilunar cartilage. An inferior ligament unites these bones below.

The chief agent in the joint to limit rotation consists of the strong tendon of the long extensors, which, arising from the external condyle of the femur, passes along the outer side of the tibial tubercle through the joint, enclosed in a fold of synovial membrane. The origin of the flexors externally likewise is a strong protective to the articulation. If the joint be suspended, it naturally rotates outwards. The anterior crucial is far stronger than the posterior. The strong prismatic ossified ligamentum patellæ anteriorly limits flexion forwards. This is connected above to the true patella, is about two inches and a half long, and below is articulated with the upper surface of the tubercle of the tibia, a synovial sac intervening between the two bones. The Haversian gland is large, and contains cells of fluid fat.

The tibio-metatarsal joint is also ginglymoid in structure, and the two bones are united by the following ligaments:—

Internal lateral arises from the upper and back part of the prominence on the inner side of the lower end of the tibia. It passes downwards and forwards, to be inserted into the internal lateral ridge on the metatarsus for about four inches. The deep internal lateral is anterior to the last, and passes from the deep pit on the inner side of the tibia, downwards and forwards, to the inner edge of the front of the metatarsus. This ligament is twisted in the extended position, and straightened as the limb becomes flexed. As this band slips over a prominent ridge on the edge of the inner side of the tibia, it gives a spring to the joint. The superficial external lateral ligament runs from the upper and anterior part of the outer side of the tibia, downwards and backwards, expanding, to be inserted into the posterior part of the outer edge of the metatarsus. The deep external lateral ligament arises in a deep pit on the outer side of the external malleolus, an inch below the last. It passes downwards and forwards, expanding, to be attached to the anterior part of the metatarsus. A distinct posterior ligament exists, covered by the great tendons lying in their sheath, which is attached to the upper border of the metatarsus by strong fibrous slips. In front, a convex fibrocartilaginous anterior ligament covers the joint, running from the tibia to the metatarsus, fibrous on either side, and cartilaginous in the centre, where it sends septa in between the various tendons.

Posteriorly and externally a rhomboidal inter-articular cartilage is observable, which is retained in its place by two bands—one anterior, passing forwards, semilunar in shape, and attached to the front of the metatarsus; another running backwards, shorter, and attached to the posterior part of the notch between the condyles of the bone. This acts in preventing over-extension of the joint, and in increasing its elasticity.

Respecting the osseous anatomy of the ostrich there are no novel points of importance observable in either of our specimens. In the pelvic arch the principal characteristic seems to be the prolongation into lines of those parts which in most other animals are represented by points, as is exemplified in the posterior inferior iliac spine, which is described in the Appendix to "Todd's Cyclopædia" as a separate sacro-iliac element; also in the elongation of the rami of the ischium and pubis. The lesser sciatic notch is also closed below and behind by a bony connecting band between the ischiatic spine and tuberosity, so as to be converted into a foramen through which the obturator tendon winds.

G. C. Garnett, M. A., read the following paper on Ancient Galleys; and presented a collection of drawings and photographs to illustrate his paper:—

On Ancient Galleys.

The subject of ancient Galleys, which I have the honour to bring before your notice this evening, is a theme, I believe, which has often engaged the attention of many learned societies, both in our own country and in those parts of the Continent which are most notable to us for their antiquarian and literary researches.

Indeed, to trace the subject from the infancy of naval art would, I believe, be vain; for it is manifest that long before any detailed accounts were written, or at least before our preserved records, a system of naval architecture existed, which was far more complicated in its nature than either the hollow boats from trees (*μονόξυλα*) or rafts joined with leather thongs (*σχεδίαι*).

The first vessel of any importance we read of is the Argo, which we know had fifty oars, twenty-five on each side; and, taking a space of four feet as a medium distance between the rowers, we have a length of 100 feet; but in addition to this was the curvature of the bow and stern—a part of the vessel in which Trajan's column exhibits no rowers or ports—and which curve would most probably be not less than seven feet, which would give a length of 114 feet, a size of vessel out of keeping with the mechanical arts of the period.

In addition to this, we know that some were shaped sharp at both ends—in other words, the bow and stern were alike; whence they are called *νῆες ἀμφίπρυμνοι*. Now, it seems highly probable that these vessels were used only for the purpose of river navigation, as their great length would be of inconvenience in turning. These, however, must not be confounded with the true *naves longæ*, a much more recent invention—vessels which had a true bow and stern. To Minerva, the happy mother of the arts and sciences, is ascribed the origin of the naval art; but at what period the idea first had birth is a question of much controversy.

Now, the Homeric poems seem a fit starting point for such an inquiry; yet no source should be disregarded which can afford any information on the subject, and in the Archipelago many vessels are still seen bearing many of the characteristics described by Homer. It was after the Punic war, or 490 A. U. C., however, before the Romans can be said to have possessed any ships of magnitude. They were divided into two classes—merchantmen, "*ὁλκάδες*," and "*νῆες*," ships of war. These "*νῆεν*" were, it is calculated, at least eight times their breadth in length; they were at first "uniremes," but afterwards were "triremes"—to a great extent, no doubt, a generic appellation to all vessels of war, just as we apply the term "liners" to vessels of 60, 78, 90, or 100 guns.

The exact form of the original triremes seems doubtful. Those on the "Columna Rostrata" of Duilius are in a great measure, no doubt, offsprings of the sculptor's imagination. M. Dupuis Delôme, the constructor of the "French Imperial Marine" investigated this subject, in order to arrive at a correct model for the French Imperial Galley, lately built at Clichy. M. Jal, the celebrated naval authority, is of opinion that triremes were constructed principally with straight decks—an innovation, certainly, on the more generally received idea of the decks being considerably curved in form. The kinds of woods used were various. The "ornus," a kind of wild ash, and the ilex, or wild oak, were employed to a great extent; the fir was also used—

"Nascitur et casus abies visura marinos."

The Romans were most particular in the wood being dry and seasoned for the purpose. Oars were first used, and indeed used in almost all cases, in the "triremes," sails being left for vessels of mercantile use. The "triremes" possessed, indeed, according to Homer, a true deck; for you cannot allow a hatchway unless you have a deck—

Νηῶν ἴκρι' ἐπῴχετο μακρὰ βιβάσθων—

and again,

—εἰς ἰκρία νηὸς ἔβαινε
Πρώρης——

Mr. Howell, indeed, holds these ἰκρία νηὸς to have been the seats or benches upon which the rowers sat; but in my opinion they were merely the raised steps, or separate flights, seen in many models and drawings, and existing in the Trinity College model. These flights were invariably placed at the ends of the Galley, as we place the forecastle and quarter-deck. Indeed, Thucydides says they had no decks—

οὐδ' αὖ τὰ πλοῖα κατάφρακτα ἔχοντας.

"Neither had they as yet any covered nor decked ships," which clearly shows the centre of the Galley to have been open. Indeed, unless this was granted, it is impossible to find out how the men that were rowing could have breathed, packed as they were in such numbers, the oar ports being so small as to afford no benefit in that way to them.

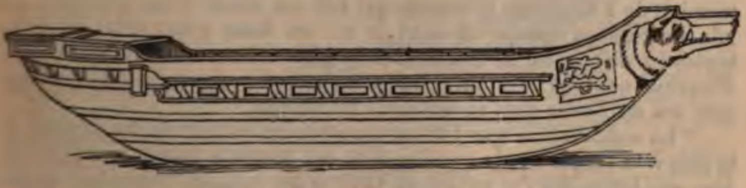
The fitting of the ancient Galley which has changed least in form from its original design is the "anchor." It was first one-fluked, ἑτερο-τόμος; but afterwards ἀμφίβολος, or double-fluked, was used. In its original form it possessed no upper bar or arm, but merely a shaft and ring. But the most formidable of all the parts of the ancient triremes was undoubtedly the prow, or beak, which was generally of brass. We read, indeed, in the life of Themistocles, that when Ariamenes, admiral to Xerxes—a good man—attacked Themistocles, both ships, meeting stem to stem, and striking each other, their sharp stems, armed with brass, pierced, so indeed that they were fastened together, and could not be separated.

And again, in the Life of Lucullus, we read that, in the Bay of Tenedos, Neoptolemus, the chief officer in command of the Galleys belonging to Mithridates, was attacked by Lucullus, who was on board a Galley of Rhodes, commanded by Demagoras, an expert seaman, whom when Neoptolemus saw he commanded the master to bear down upon him with all imaginable force; but Demagoras, fearing the beak and massive stem of the admiral's Galley, refused to meet him ahead; wherefore, tacking about, he received him astern, in which part, though indeed the shock was very great, he suffered no damage.

Now, this plainly shows that the curvature of the stern must have been at a considerable angle to the water, and that the stem or beak ran as if it were in and under the counter of the Galley. This hollow in the stern was left, no doubt, for the action of the rudder.

The ancients seem to have had no limit to the size of these Galleys. The largest we read of was that of Ptolemy Philopator. This enormous vessel was merely, it has been conjectured, built for show: she had 40 banks of oars; she was 280 cubits in length, about 420 feet,—the length of the iron-plated frigates, Minotaur and Achilles.

The subject of frequent dispute is, how these Galleys have been rowed or put in motion. M. Le Roy, in his "Sur la Marine des Anciens" (Academie des Inscriptions), M. Jal, in his "Archeologie Navale," and others of a later period, have made investigations into this subject. One of the chief obstacles to the settlement of this question is the want of any accurate drawing or bronze existing by which the *interior* of the hull could be seen, with the arrangement of the seats. Few models, indeed, exist. There is one in the Museum of Trinity College, which I consider a most important model. It is a monocrota, or unireme; the boar's head, the distinguishing feature of the Roman triremes, points to its Roman origin. Its length is 9 feet 7 inches; breadth, 3 feet 4 inches; and depth, 1 foot 5 inches—of which the underneath is a representation:—



How it came into the possession of Trinity College is a mystery. Neither in Dr. Stokes' nor in Dr. Ball's time (both Curators of the Museum), did any circumstance arise to throw light on this most interesting model's origin.

There is another in the Campaggio at Rome, and some marbles at Naples, in the Museo Borbonico, while a few solitary frescoes have been discovered at Pompeii, in an injured state.—See Zahn and Ternité.

Before I proceed to state the various theories connected with the rowing, I must acknowledge the great kindness of M. Auguste Jal, the eminent historiographer of the French navy, who addressed the following letter to me, through the Consul-General of France for Ireland, Mons. George Livio. It is concerning the Galley lately constructed at

Clichy, on the Seine, for the Emperor of the French, and a photograph of which will be found in the volume of "Ancient Galleys from the Antique," presented by me to the Royal Irish Academy.

To G. G. Pattison, Esq., of the Edinburgh Academy, and George Hill, Esq., of the Royal Antiquarian Society of Scotland, I beg to return my best thanks.

The following is a copy of M. Jal's letter:—

"*Paris*, 24 *Mars*, 1864.

"MONSIEUR,—La galère impériale-trirème construite près de Paris est à Cherbourg d'où elle ne sortira probablement point. L'Empereur n'en a point fait graver les détails et il n'en existe pas de reproduction photographique, qui au reste n'aurait point d'intérêt dans la question dont il s'agit parce qu'elle montrerait seulement l'extérieur et que ce sont les dispositions intérieures qu'il importe de connaître pour se faire une idée exacte de la position et de l'organisation des rames.

"Mais si aucun portrait ne peut être offert au savant Irlandais qui veut s'occuper des navires à rames de l'antiquité, il existe un petit livre où toutes les questions qui touchent à la construction des galères sont traitées avec tout le soin dont l'auteur est capable, livre qui fut publié par ordre de l'Empereur et à ses frais. C'est celui qui a été consulté lorsque sa Majesté a voulu que M^r Dupuy de Lôme construisît un navire à trois rangs de Rames. Il est intitulé:—

"*La flotte de César, &c.* Par Auguste Jal.

"Il a été publié en 1860 *chez Didot, rue Jacob,* 56. Je conseille au membre de l'Académie d'Irlande qui fait son étude d'une question qui m'a long-temps occupé et dont je ne me flatte point d'avoir résolu toutes les difficultés, de se procurer le petit volume où il trouvera mon *Virgilius nauticus* à la suite du mémoire sur la flotte de César, et une note sur un Bélier dont se servaient les anciens.

"La connaissance que j'ai pu acquérir des choses de l'antiquité, je la dois à la longue étude que j'ai faite des marines obscures du moyen âge, sur lesquelles j'ai publié en 1840 deux volumes intitulés: *Archéologie navale*. Ce travail est bien connu en Angleterre où plusieurs auteurs l'ont cité et mis à profit.

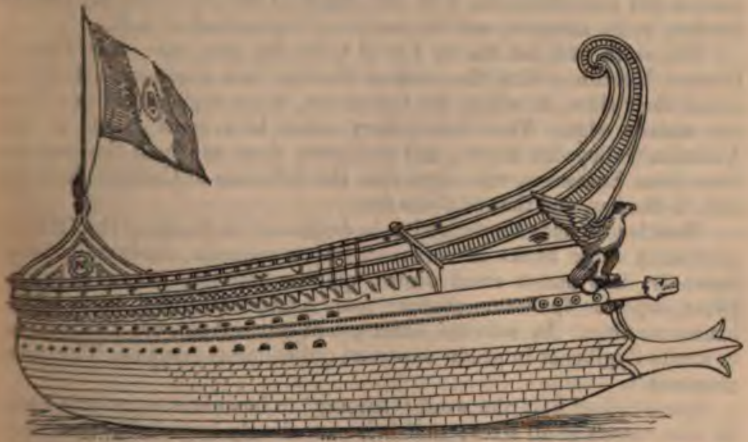
"Les questions qui intéressent les marines anciennes sont de celles qui veulent de longues études; bien des systèmes ont été proposés qui venant d'hommes étrangers à la marine pratique ne sont point acceptables pour nous dont l'éducation a été celle du matelot et de l'officier. Il faut se défier beaucoup des travaux des savans qui ont examiné seulement les monumens et les textes, mais qui n'ont pu les voir avec les lunettes du marin.

"Si j'avais un exemplaire de *la flotte de César* j'aurais l'honneur de vous l'adresser, mais je n'en ai plus. Les libraires de Dublin le feront venir, et votre ami aura là tout ce que j'ai su de la marine antique, et malheureusement c'est beaucoup moins considérable que je ne l'aurais voulu.

"J'ai l'honneur d' être, Monsieur,
"Votre serviteur très humble,
"A. Jal.

"Le volume que j'ai l'honneur de vous signaler est orné de gravures, et à la page 156 se trouve une coupe de la trirème avec ses avirons, qui fera fort bien comprendre ce qui a été exécuté dans la construction de la trirème impériale, et qui a très bien réussi,—car la trirème marchait très bien, et elle eût marché mieux encore si les rameurs avaient été de ces *remiges* Romains, des gens que l'habitude de vivre sous et au soleil, et un long usage des rames rendaient si forts et si capables de longues fatigues. Nos matelots de Cherbourg étaient bons et solides, mais quelle différence avec ceux qui maniaient la rame sur la mer Ionienne et sur les côtes de Carthage!"

By the kindness of a friend at Cherbourg, I was enabled to procure a photograph of the French Galley for the Academy, an outline of which is here given, and which has been engraved in the "Illustrated London News:"—



Up to the present time, no fewer than six theories concerning the rowers have been put forward.

The first solution of the question has been founded on a passage from the Emperor Leo, and quoted by Morisotus, in his "Orbis Maritimus:"—

> "Every ship must have its due length,
> Having two ranks of oars, the one higher than the other."

The difficulty in this case is manifestly, assuming one range of oars higher than the other, to have been one perpendicularly over the other—a system totally impracticable.

The second theory has been maintained by Stewechius and Castilonius, namely, that the oars were in a broken line—three together, and then a space intervening, and then three again; yet all on the same line. Now, this would entail a great loss of power, and gain no advantage.

The third is that of Sir Henry Saville:—That the oars rose at an angle of 50° to the deck of the vessel, yet having only one bank of oars, each series of steps containing a rower. The objection to this theory seems to be the amount of beam not being in keeping with the term "naves longæ," which were eight times as long as broad.

Vossius' theory is the fourth, that three men pulled at the same oar; yet in a πεντηκόντορος, if this theory is held, 100 men must have stood across the beam of the Galley; and supposing only 50 stood so, and the oars not to be in the same parts of the Galley on each side, we have 8 times 50 (giving each man a foot to stand on), 400 feet, as the extreme length of the rowing part of the Galley, without counting bow and stern curves—a length utterly absurd.

The fifth theory is that of Le Roy, and is certainly a step in the right direction, viz. that the oars were in an oblique line, yet one above, or higher than the other, in a checquer form, but only one man to each oar—a fact irreconcileable with the length of the oars used, 57 feet in Ptolemy's, for instance, and the weight of lead attached to it.

The sixth and last theory I hold to be the true one: it is that of General Melville,—that the ancient Galleys had a gallery extending round their sides, in which the rowers sat, at an angle of 45° or 50° to the water's edge. That this gallery exists to a great extent in the Venetian Galleys we know; and that more than one used the oar we learn from Suetonius, who says that the Liburnæ of Caligula had ten men to the oar, and that of Caius five.

Montfaucon adds the following in defence of his theory of the Galleys possessing three banks of oars:—"Supra majorum nauium carinam latera in tres partes erant diuisa, quarum inferior, θάλαμος, media ζύγια, superior θρᾶνος uocabatur; unde remiges quoque diuersa sortiebantur nomina. In inferiori enim gradu qui stabant, eos Thalamitas, in medio Zygitas et in gradu superiori qui collocati erant eos Thranitas uocabant."

Some indeed hold the word "trireme" to have been a generic name for war vessels of all sizes; that it is exceedingly improbable that more than three rows of oars were ever in use; and that the words "hexiremes," "quinqueremes," &c., were more applied to the size of the vessel than the number of oars; that no vessel of five ranks of oars, one over the other, could be propelled, I believe certain; that the number of men to each oar varied with the size and weight of the oar, I think also to be an indisputable fact.

Dr. Smith says that the thalamites were placed immediately under the thranites, but covered by the platform or gangway on which the thranites sat. That they did not interfere with each other is indeed manifest from Dr. Smith's experiment, designed by himself, which he explains in the following terms:—"I cut two oar-ports to represent the row-locks of the zugites, at a distance of 3 feet 6 inches from centre to centre, which is the distance allowed in the launches of a man of war, which are pulled 'double-banked,' or with two rowers on each bench, as in the ancient Galleys; and I found that by cutting an oar-port fourteen inches below those of the upper tier, and about one-third of their horizontal distance, reckoning from bow and stern, a rower seated on the deck, and rowing in the lower port, was not interfered with by the rowers seated on benches nearer the centre of the vessel, and rowing in the upper oar-ports." Whether, indeed, the height of the thranites' oars was only five feet from the water, is still an open question. Dr. Smith, it must be confessed, at least deserves the warm thanks of the antiquarian for taking such a deep interest as he has done in the subject, and aided his great knowledge of these various theories by such a highly interesting and valuable experiment.

The fact of the imperial trireme having been rowed with comparative ease from Clichy to Cherbourg, I think, must also be a conclusive argument against the theory of Sir H. Saville, of only one row of oars existing.

Perhaps, of all the various theories concerning the manner of rowing these Galleys, that of General Melville is open to the least objections; the extended gallery would give facility for using the oars, and its being inclined at an angle of 45° to the water's edge would render the height of the uppermost tier within the bounds of probability. That more than one row, or tier of oars, existed, indeed is evident from the fact, that when two Galleys met in conflict, the oars of the different tiers could be suspended from the outside of the ports, which would have been impossible if they reached within the Galley more than a certain distance, which a great number of hands or rowers would necessitate. Dr. Leonhard Schmitz tells us, that more than three ranks of oars were not in construction in Greece till about the year 400 B. C., when Dionysius, the tyrant of Syracuse, who bestowed the greatest care upon his navy, first built *τετρήρειν*, the model of which class of Galley is ascribed to the Carthaginians. The *ἑξήρεις* are ascribed by Polybius to the Syracusans—a fact also mentioned by Ælian.

That when these vessels exceeded a certain size they were practically of no value for war purposes, is indeed evident from their description. Montfaucon, for instance, describes at length the great ship built for Hiero by Archias, which consumed as much timber in her construction as would have sufficed for sixty Galleys of the trireme class. This wood was brought from Mount Etna, Italy, Sicily, Spain, and the Rhone. It took three hundred skilled artizans six months to complete her; and, in order to launch her, they had to invent a machine called a helix. Yet, like Ptolemy's great ship, she was considered a mere hulk upon the water, that was indeed of but little use for any effective purpose.

In conclusion, the rate of these Galleys is not very accurately known. Admiral Beecher, however, is of opinion that a speed of seven miles per hour was the average; and J. Smith, Esq., F. R. S., in his "Shipwreck of

St. Paul," mentions that Adrian set sail about daybreak, and at noon had obtained a distance of 500 stadia,—*καὶ ἤλθομεν πρὸ τῆς μεσημβρίας σταδίους πλείονας ἢ πεντακοσίους*, or more than fifty geographical miles—a speed of at least eight miles per hour.

That, indeed, the subject of Ancient Galleys is of great interest, and one fraught with many difficulties, I think will be acknowledged by every classical student. In the various remarks concerning the manner of rowing these ships, I have not pretended to solve the difficulties; but rather to place in a concentrated form the various theories of the most eminent writers on this subject.

The Secretary of the Academy read a paper, by Lord DE ROS (communicated through the President)—

ON THE CONSTRUCTION OF ANCIENT GALLEYS, AND THE ARRANGEMENT OF THEIR OARS AND ROWERS.

THERE are few subjects which have attracted more notice and discussion among classical students, than the details of the navigation of the Greeks and Romans; and this matter seems doubly interesting, from the probability that in any future naval warfare, we may see practised (though with far more terrible and destructive effect) by the steam rams of late invention, the very same manœuvre of charging "prow to prow" which we read of at Actium and other great sea fights of ancient times.

Propelling by steam, whether by the use of paddle-wheels or screws, brings back, in truth, after the lapse of so many hundred years, the great principles of naval warfare to several of the same conditions which arose from the propulsion by oars; and, indeed, it is only of late years that the speed of steam vessels has been brought to exceed so vastly that of the row Galleys of former times.

In that amusing book, Smollett's "Travels in Italy," about the year 1760, he describes the mode of coasting from Spezzia to Nice by passage boats, rowed with oars, as by no means a tedious way of travelling, when favoured with tolerably smooth water; and the writer of this Paper recollects, when on a military mission to the Black Sea, in 1835, that the "Pluto," a man-of-war paddle steamer, in which he traversed that sea both from E. to W. and from N. to S., took six days for the former, and three for the latter passage; which is the very time mentioned by Strabo as occupied by a Galley of his day in performing her *πλοῦς* of those very same distances in the Black Sea.

It must be mentioned, however, that the "Pluto" was a gun brig converted into a steamer, and of such inferior quality, that, when going at her best speed, seven or eight knots was all she could accomplish. Now, there is no doubt but a Greek or Roman Galley could fully perform that rate, and even more, for short distances, and in smooth water. But to attain any rapid speed with oars, it is scarce necessary to say that the rowers must have good room, and scope for the stretch of arm and play of every muscle. A cramped position, or an ill-balanced oar, especially if heavy overboard, and without the proper proportion of leverage from the handle to the vessel's side, will very soon fatigue and cripple the stoutest and most expert oarsman.

In accepting, therefore, any theory as to the arrangement of the rowers and rowing benches of the ancient Galleys, we must never lose sight of certain conditions, familiar to all who are accustomed to the uses and application of the oar.

In the first place, we will consider the length of oar which can be used with the best effect by a single individual.

The most approved length in the present day for rowing those numerous matches which are daily occurring during the summer months in every part of Great Britain (for there is hardly a creek large enough to float a boat where you will not find a rowing match advertised once or oftener every year), the most approved length of the oar is from 12 to 13 feet. In some sea-shore matches, oars may be found of 15 or 16 feet; but that is quite the limit to which the length of a "match" oar is carried in the present day.

The proportion overboard and inboard (being the leverage exercised in drawing the oar through the water) is the next consideration; and it is generally held by good oarsmen that the oar should be about twice and a half as long overboard as it is inboard—that is to say, if the oar be 3 ft. 6 in. inboard, there should be a length beyond the rowlock of 8 ft. 9 in. outside the boat.

At the Great Exhibition, some oars, from America, were shown, of about 40 feet in length, and we see oars nearly as long used in the Thames' coal lighters; but these are only used in guiding the craft in the stream, and the strongest man could not move them fast enough for propelling even an empty lighter through the water faster than one mile an hour. Gun brigs were formerly provided, by the regulations of the navy, with a few sweeps, of 36 feet long; but these were only used for an occasional effort to move the vessel a short distance, and in dead calms—quite a different thing from regular "rowing." In fact, it may be safely asserted that 16 feet is the very longest oar that can be applied to rapid motion by a single rower. But if we admit the theory of the trireme having three men to each oar, there is no doubt but that oars of 26 or 28 feet long may have been used by them.

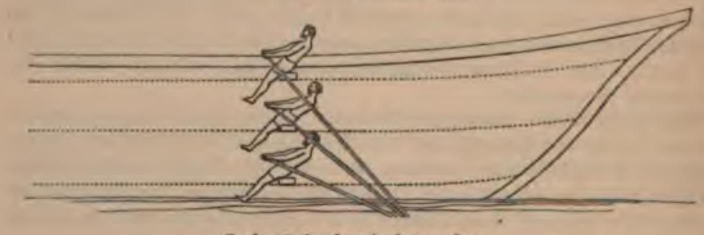
It is the manner in which these oars were placed that we have now to consider, reconciling, if possible, the practical use of the oar with the theories which have been set up as to the terms "trireme," "quinquereme," &c., so constantly occurring in the ancient historians, and so variously explained by their translators and critics.

Many of these have, in their ignorance of maritime detail, adopted the notion that a trireme had three rows of oars, worked each by one rower, and that the transtra, or benches, were one over the other; in other words, that a trireme was a sort of three-decker, only of oars instead of guns.

Now, as the very lowest height in which a man could sit in a rowing position is 4 ft. 6 in., and as the lowest height of the lowest range of oars in a sea-going Galley, must be about 2 feet from the water (see Diagram A), a trireme, thus constructed, would present a side of 13 feet high, or thereabouts, above the surface of the water,—far beyond what can be allowed, with any probability, for any vessel impelled by oars. Indeed, this is as high out of water as our old thirty-six-gun frigates, and such a vessel could have no stability without such a draught of water and weight of ballast as must entirely unfit her for propulsion by oars. To haul her up on the shore (as we know they hauled up the Galleys), would have been utterly impossible.

DIAGRAM A.

Height out of Water, 13 feet.



Scale, $\frac{1}{16}$th of an inch to a foot.

Here it may be well to call attention to the remarkable fact, that nowhere in the classical authors can any mention be found of the use of *ballast* for their Galleys,—a fact which shows how entirely the ancients considered sails as a mere adjunct to the use of the oars, *ballast* being as obstructive to the requirements of a vessel propelled by oars as it is necessary to a vessel which depends upon sails for her propulsion, as well as for her stability and safety.

It may be said, in answer to this, that Virgil, in the Fourth Georgic, does allude, by the term "saburra," to ballast, when he describes the bee as taking up a small weight to steady itself in its flight; but it is evident he is alluding to light skiffs, used in fishing, which took sand on board to steady them, and not to large war Galleys, which, if ballasted, could neither row fast, nor be hauled up on the beach, as we know was their frequent custom.

There is another point connected with the absence of ballast in the ancient Galleys: it explains, what otherwise seems so strange, "that they never attempted what is termed beating to windward," but always used oars to go against the wind, and only hoisted the sail to run before it. In fact we find, both in Homer and Virgil's description of sea storms, that the approach of bad weather was the signal for striking sail, and taking to the oars,—very different from the seamanship of these days.

Æneas, when narrating the storm in which his fleet had been caught, and tossed in danger and darkness for three days, tells Dido, that on getting a glimpse of land, "remis incumbimus," having previously lowered their sails,—showing that it was the oar, and not the sail, on which they put their reliance in time of danger and difficulty.

Beautiful and picturesque as is Virgil in his descriptions of vessels caught in a storm at sea, a very cursory comparison must show the observant student, that Virgil possessed little of that practical knowledge of vessels and seamanship, which we find in Homer. Virgil describes his storm with all the fire and grandeur of poetry, but Homer adds considerable practical knowledge of maritime details to his sublime powers of painting the "wonders of the deep," as seen and felt by those "who go down to the sea in ships;" witness his admirable description in the "Odyssey" of the way in which Ulysses managed to rig up a sail, and contrive a steerage for his raft, when he escaped going to the bottom with his vessel. It is just the account which a thorough seaman of our time would give of such an adventure, and is as intelligible to a Torbay fisherman as to an educated student, perhaps in many cases much more so. And here occurs the consideration of a most important feature in ancient seamanship,—the invariable use of a steering oar or paddle instead of the rudder, which last contrivance we can trace back to the ships of the Norman and Danish sea kings, but not to classical times.

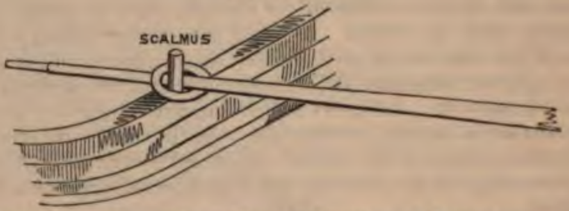
It is clear that the "steering oar," or "gubernaculum," was not attached to the vessel's stern, but independent of it. . . . . "Gubernaclum multa vi forte revulsum præcipitans traxi mecum" is the description (and most animated and spirited it is) of the means by which Palinurus tells Æneas, in the Shades, that he escaped drowning, when knocked overboard by the fraud of Somnus—showing that he was steering exactly as the coxswain of a whale boat does at the present time, which is done by a skilful turn and pressure of the oar on the quarter of the boat, and not by any fixed machine of the nature of a modern rudder.

The number of rowers for a trireme in the Punic wars was estimated at 300. Now, taking the length of the Galley to be about 120 feet, and allowing some space forward and aft, as would be of course necessary, we shall find there would be length for about 25 transtra, at 4 feet apart; and, placing six men on each transtrum, three to each oar, we shall just arrive at a complement of 300 rowers in a trireme Galley—a few feet longer than one of the Thames steam-boats—while the width of 13 feet would give each rower a lateral space of full 2 feet, which is enough for the free use of his arms, and shoulders.

Montfaucon, with his usual accuracy, gives a *précis* of the different views taken by the commentators and critics of the arrangement of the rowers and oars on board the Greek and Roman Galleys; but, being himself unacquainted with such matters, he contents himself, wisely, with placing the different theories before his readers, and leaving them to form their own judgment.

No doubt there are many medals and sculptures which represent Galleys with more than one range of oars; but, if examined closely, it will be found that from almost entire absence of proportion, and little regard to perspective, no reliance can be placed on such delineations, for elucidating and explaining the details, of the rowing arrangements of the Galleys of the ancients. In several medals we see the oars simply projecting through small round orifices—a thing manifestly inconsistent with the necessary power of letting the oar swing alongside, or even stowing it on board, when at anchor, or under sail; besides, we have many proofs that the ancients worked their oars on a peg, "scalmus," with a loop, or grommet, through which the oar was passed. The term "colligere arma" was applied to the operation of stowing the oars, as well as to striking and stowing the mast and sail. (See Diagram D.)

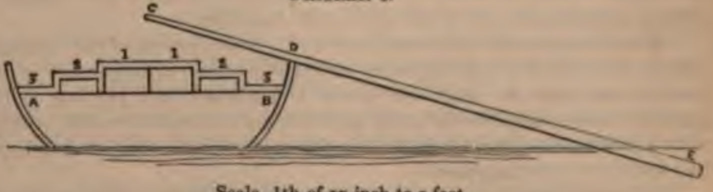
DIAGRAM D.



In that elaborate work, "The Antiquities of Herculaneum," compiled by some of the most learned of the Italian Academicians of the last century, there are (among many preposterous representations of ancient Galleys) one or two, which greatly favour the opinion, that there was but one range or deck of oars, and that the terms of trireme and quinquereme applied to the number of men who handled each oar,—the only theory which can be reconciled with practical results, and which was exemplified in the French, Maltese, and Spanish Galleys of the seventeenth, and early years of the eighteenth centuries.

Having endeavoured in short compass, and we fear in a very imperfect manner, to expose the difficulties which attend any attempt to reconcile the theory of banks of oars, one above the other, with the practical use and requirements of the oar, we now proceed to the question whether a solution may not be arrived at, by adopting the proposition (see Diagram C) that the terms "trireme," "quinquereme," &c., meant simply the number of men who handled each oar, and not a number of banks or decks, one over the other, with one man to every oar.

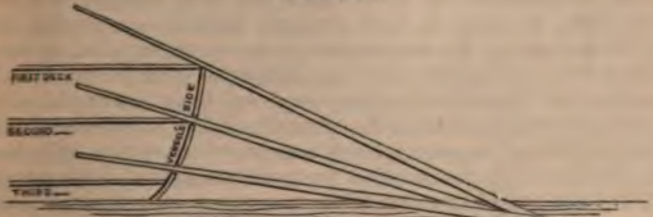
DIAGRAM C.



Scale, ⅛th of an inch to a foot.

In the first place (taking the case of a trireme), an oar which would rest on a fulcrum eleven feet above the water level (see Diagram B), as must be the case with the top row of oars, if the theory be admitted of the rowers being one above the other, in tiers or decks, could not even reach the water, unless it were thirty-two feet *overboard*, to balance which you cannot allow less than twelve feet *inboard*. Now, such a long oar as forty-four feet would be quite beyond any man's handling, even if he stood up, as you see the London lightermen doing; besides, Virgil uses the expression "considunt transtris;" and a standing attitude would be far too fatiguing for rowing any long distance, or at any rapid rate, no matter whether in a large Galley or a small boat. Then, to use oars of any such length, you must suppose a Galley to be twenty-six feet wide, which is entirely inconsistent with any degree of speed under oars.

DIAGRAM B.



Scale, $\frac{1}{16}$th of an inch to a foot.

Sir Walter Raleigh, as thorough a seaman as he was an able and gallant soldier, observes, in a note to chapter i., book v., of his "History of the World," that "Some have thought that quinqueremes had 5 ranks of oars, one over the other, and the triremes 3; but had this been so, they must then have had 5 decks, each over other, which hath seldom been seen in ships over 1000 tons; neither could the 3rd, 4th, and 5th ranks have *reached unto the water with their oars*."

But, as we are met by so many difficulties in endeavouring to discover the arrangement of the oars in the Galleys of the Greeks and Romans, will it be deemed unreasonable to suggest, that, after all, the Maltese Galley of the seventeenth and early part of the eighteenth centuries was probably a sample of the vessels of that class which had for hundreds of years been the common war vessel of the Mediterranean? No doubt, many improvements may have been made upon those of the Greeks and Romans; but it certainly is the universal opinion of scientific and experienced seamen who have frequented Malta, that, with all our present skill in construction, it would be impossible to produce a swifter or better vessel for propulsion with oars than the Maltese Galley, a very elaborate model of which was transferred some years back from that island to the United Service Museum in London. She is twelve feet long, and every detail is so accurately executed, that the most fastidious naval critic can discover nothing faulty in her construction. The form of the hull is exquisitely moulded for speed; and it is curious how closely it resembles, though in more delicate lines, and with less proportional width, the shape of those fast and beautiful little steamboats which ply daily between London-bridge and Chelsea. Remove their paddles and machinery, and equip them as triremes, and you would probably turn out a Galley with which a Greek or Roman shipwright could have found few faults.

The dimensions of these steamboats (which have been ascertained in reference to this discussion) are as follows :—

	Ft.	In.
Length, ...	110	0
Width, or beam, ...	13	0
Draught of water, ...	2	0
Height of deck from surface of water, ...	3	10

It is the great merit of these vessels that their draught of water is so very little, in regard to their size and stability—an element of no small consequence in the construction of any vessel impelled by oars.

Those who are familiar with that delightful work of the immortal Cervantes, will remember the picturesque and lively description of Don Quixote and Sancho's visit to the admiral's Galley at Barcelona, where the author (himself an accomplished seaman, who mentions, with honest pride, the loss of his own hand at the great sea fight of Lepanto) gives a spirited and graphic account of the manœuvres of a Spanish Galley, renowned for speed and beauty, in her rapid chace of a corsair. Any one who will peruse this narrative, and then inspect the Maltese model, before alluded to, will hardly entertain a doubt of the identity, in general form and arrangement, of this kind of vessel with the Galley of Greece and Rome.

In one respect (but in reference to the rowers, and not the vessel), a wide difference is to be remarked. The art of rowing, which was estimated so highly by the ancients, had degenerated in latter times into a labour for slaves, and was considered the vilest of toil :—

> "Some, plunged in mines, forget the sun was made;
> While others, deathless as their haughty lords,
> Are hammered to the galling oar, for life,
> To plough the winter wave, and reap despair!"

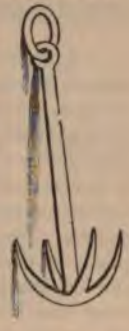
To show how differently the Greeks viewed the skilful handling of the oar, we have the curious story in the "Odyssey" of Elpenor, who fell down drunk from a tower, and broke his neck. So proud does he seem to have been of his "rowing," that, when his shade is represented entreating for funeral honours to his corse, he specially requests that an *oar* may be the distinguishing emblem upon his tomb! Pope's translation of the passage is too graceful to be omitted :—

> "Then, high in air, memorial of my name
> Raise the smooth oar, and bid me live to fame."

This paper has now, it is feared, exceeded due bounds, but there is one point, in regard to ancient navigation, too remarkable to be passed over, and which does not seem to have attracted much critical observation. The anchor is one of the most valuable and necessary equipments of a vessel, from the three-decker to the fishing smack; it is the simplest and most effective of contrivances; it has taken a place in poetry, in painting, and in sculpture; it is become an emblem introduced in allegory, and in metaphor, as well as in our every-day conversation. Is it not most strange, then, that we cannot trace the form of an anchor in any sculpture, or description by classic authors?

The *λίθος τρητός* and the *εὐναί* were just heavy stones, used, as we see even now in fishing skiffs, for mooring; but they were not anchors. Virgil's expressions of "dente tenaci, et unco morsu," prove that the ancients had some sort of curved hooks for mooring their vessels; but it is very doubtful whether the form was at all like that of our anchor; it seems rather to have been a sort of grapple, such as a man-of-war's boats are usually provided with (Diagram E), but which has been quite superseded in our times by the "anchor" for vessels of any burthen.

DIAGRAM E.



With one more observation we shall now conclude. Much stress has been laid by some critics on certain technical terms, which they hold to bear upon the arrangement of the oars of ancient Galleys, especially the three designations of *θαλαμίαι*, *ζευγῖται*, and *θρανῖται*.

Now, there is no profession or art more remarkable for all manner of misapplication of terms than that of the seaman. What will the student or professor of five hundred years hence be able to make of the term "forecastle?" Will he ever guess that in a small merchant vessel it means, not even an elevation, or turret, but a low, dark place, forward, more like a dog kennel than a castle, where the seamen hang their hammocks for sleeping? Will he ever guess that a "messenger" means a piece of chain? or that a "sheepshank" is a peculiar knot for shortening a rope, and has no sort of connexion with a leg of mutton? Will he discover that the "boatswain" has charge of the ship's sails, ropes, and spars, but has little to do with the *boats?* And, above all, will he ever imagine what is meant by the term commonly applied to our large class of frigates, about twenty years ago, of "double-banked frigates?"—a term which was solely applied to vessels with guns placed along the whole upper deck, and without the smallest relation to *banks* or *benches* of any kind? And if these incongruous terms puzzle him, what in the world will he think of a class of vessels, common in our navy about thirty years ago, and called by the name of "donkey frigates?"*

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* Since the above was laid before the Royal Irish Academy, it has come to the knowledge of the writer, that a very similar question having been recently raised among the learned in Paris, it was resolved by the Emperor, with his usual practical acuteness, to test the matter by actual experiment. The savans were accordingly placed in commu-

MONDAY, APRIL 25, 1864.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The Secretary exhibited an original Bull of Pope Innocent IV., with the leaden seal attached, belonging to the Public Library of Armagh, the tenor of which is as follows:—

"Innocentius episcopus servus servorum Dei dilectis filiis Archidiacono Glindelacensi, Priori Sancti Johannis de Tristeldermod, Dublinensis diocesis, salutem et apostolicam benedictionem. Conquesti sunt nobis Prior et Conventus Sancte Trinitatis Dublinensis ordinis Sancti Augustin, quod Prior et fratres Hospitalis Sancti Johannes extra novam Portami et quidam alii clerici Dublinensis Casselensis et Darensis civitatum et diocesium super decimis terris possessionibus et rebus aliis minantur eisdem. Ideoque discretioni vestre per apostolica scripta mandamus quatinus partibus convocatis audiatis causam, et, appellatione dempta, fine debito terminetis, facientes quod decreveritis per censuram ecclesiasticam firmiter observari. Testes qui fuerint nominati, si se gratia odio vel amore subtraxerint, censura simili, appellatione cessante, cogatis veritati testimonium perhibere. Datum Laterani ii. Nonas Martii, pontificatus nostri anno primo."

Innocent IV., whose name was Sinibaldo di Fiesco, was elected Pope on the 24th of June, 1243, so that this document is of the date 1244.

The Rev. Professor Haughton read a paper "On the Semi-diurnal Tides of Cahirciveen."

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nication with the ablest shipwrights of the French dockyards; and a trireme was built upon the principles maintained by the former, with a single rower to each oar, and three distinct levels of rowlocks, or portholes, for each range of oars. After spending infinite pains and much expense in the endeavour to reconcile the three ranges of oars with the real requirements of a vessel propelled by oars, the model trireme was launched, and tried upon the Seine. It proved a signal failure; no exertion could drive the vessel above three miles an hour against a sluggish stream, and the labour of the huge oars soon exhausted the rowers. But the Emperor was not content with a river trial; he insisted on her being tried at sea; and here the failure was far greater than in the smooth water of the Seine. The trireme proved quite unmanageable, and it was not without much risk and difficulty that she was towed back into harbour by the steamer prudently sent out to attend the experiment.

Sir W. R. Wilde exhibited, on the part of Marcus Keane, Esq., and deposited on loan in the Museum, the reliquary known as the Clog Oir, or Golden Bell of St. Senan.

The Rev. Dr. Todd presented the following collection of antiquities, on the part of Mrs. Ogilby, of Kilcattan:—

A wooden chopping-block.

Two wooden blocks, shaped like human heads, probably used as butts by stone throwers, or parties using slings.

The upper part of a circular wooden vessel, made out of one piece, ornamented with two carved bands, resembling hoops.

Three four-sided methers.

A wooden cup.

Three cinerary urns, found at Altahony and Dring.

A stone cup, similar to one represented in Wilde's "Catalogue," vol. i., p. 87, Fig. 87.

Two flat circular stones, resembling weights.

Portion of a stone handle of a stamp or seal.

A touchstone, dug out of an old fort at Teononey, county of Derry.

Six stone celts, of different sizes.

One stone celt, the surface curiously stained and weathered; found in the county of Derry.

Ten Irish flint arrow heads, of different forms.

A bronze spear head, with lateral loops.

Four bronze hatchet-shaped celts, different patterns.

A bronze pocket celt.

A bronze pin, with lateral shield-shaped ornamented head.

Fragment of a bronze cross, with crystal setting.

A brass seal, with arms and crest—a reaper holding a sickle in one hand, and a head of wheat in the other. The letters S. M. I. are in the upper part of the field.

Two iron ploughshares.

A specimen, parched oats, found when sinking Kilcattan cellar.

A specimen of bog butter, in a bottle.

Upper stone of a quern, with driving hole at the side.

Upper stone of a quern. In neither of these specimens was there any contrivance for centering the stone.

Lower stone of a pot quern. It is broken at the side, and the central hole has been carefully closed with lead.

A portion of blue flag, with an ancient Irish cross and circle, in relief, carved on it.

The following articles were also presented:—

A fragment of Roman mosaic, from Pompeii.

Seven fragments of enamel, probably Roman.

A small globular urn, very highly burned, ornamented with small dots and four raised points.

Two Indian stone hatchets, with grooves for holding handles, found in Somerset County, New Jersey.

Eight Indian stone arrow heads, of different forms.

A very perfect stone Indian celt, from Yona Mountain, in Georgia, C. S.

An ornamented bronze ring.

A brass celt, with an iron rivet on it, apparently a modern forgery.

A stone with differently shaped hollows on its surface, like moulds.

A modern spring spur, of a peculiar form.

Two large lateral circular brass buttons, with appendages like earrings, probably Indian ornaments.

A large clay tobacco pipe, with stand.

A small pipe of the kind commonly called Danish.

The thanks of the Academy were given to the donor.

MONDAY, MAY 9, 1864.

The Very Rev. Charles Graves, D. D., President, in the Chair.

Charles Philip Cotton, Esq., C. E., was elected a member of the Academy.

Professor Downing read a paper "On the recent Failure of the Bradfield Reservoir, near Sheffield."

MONDAY, MAY 23, 1864.

The Very Rev. Charles Graves, D. D., President, in the Chair.

Mr. E. A. Conwell read a paper—

On Ancient Remains, hitherto undescribed, in the County of Meath.

My object in bringing this paper before the Academy is to direct the attention of antiquaries to a great field for observation which has hitherto passed unnoticed, and the thorough and systematic exploration of which will, I feel assured, do good service to the cause of antiquarian research.

In the extreme north-west angle of the county of Meath, about two miles south-east of the village of Oldcastle, and in the direction of the town of Kells, the hill of Sliabh-na-Cailligh e, rising to the height of 904 feet, and being the only eminence in the county assuming the name or character of a mountain, makes a prominent feature in the landscape. It is forced out of the Lower Silurian rocks, which occupy a large extent of the country to the northwards, from Drumlish, in the county of Longford, to Donaghadee, in the county of Down, including the range of the Mourne Mountains.

The longest axis of Sliabh-na-Cailligho is from west to east, and its extent about two miles.

To the south and west of the hill lie the comparatively low, undulating, limestone plains of Meath and Westmeath, and on the north the slate rocks occupy the low grounds around Lough Ramor. In form the hill consists of three main peaks, two of these still crowned with large tumuli and smaller cairns; while on the third the work of demolition is going on even at the present time—Mr. Edward Rotheram, of Crossdrum, having had men engaged for years past in carting away the stones of a large tumulus, for the construction of adjoining fences. There are, besides the three principal peaks, two minor hills, extending from the middle in the direction of the western peak, each also crowned with the remains of ancient cairns.

The prospect from the summit of any of these peaks is not to be surpassed for pastoral beauty by any other locality in Ireland; and it would be impossible to select a more fitting and commanding site for the necropolis of a tribe than that which has been chosen—*on the very confines of Leinster and Ulster*—by the cairn and cromlech builders who inhabited the prairies of central Ireland.

For years these great cairns—composed of dry, loose stones, and the massive, rude, stone chambers which I am about to describe—have found no better interpretation in the eyes of the peasantry than what is contained in the local legend:—That "an old hag (name and date not given), with her apron filled with stones, jumped from one peak to another, scattering a few on each peak, and leaving her chair on the middle one."

Some years since, passing in the neighbourhood, and observing from the plain one of these cairns, I inquired what it was; when I was at once informed that it was an erection on which the officers of the Ordnance Triangulation Survey had placed their flag. But it at once occurred to me that such immense piles of stones as I observed on the summits of the peaks of Sliabh-na-Cailliglhe could scarcely have been erected by the Ordnance Survey officers, as the labour and cost of making them would be more than commensurate with the advantage to be derived. I therefore examined the place; and although, during the first two attempts, I was driven from the mountain by storms of hail and rain, I persevered, and was gratified by the discoveries which I now lay before the Academy.

I may just mention, that, on consulting the Ordnance Survey Townland Maps, I find that the only notice taken of these very interesting remains of antiquity is indicated by a mere dot or two, with the words "stones" appended; and this may have caused the place to be passed by and neglected, even by such accurate observers as Sir W. R. Wilde, who must have been looking at these cairns, from no great distance, when he commenced to write his graphic description of the Blackwater, where it issues from Lough Ramor.

I only trust that future explorations may turn up some curious details for an additional chapter in the next edition of that interesting book.

My friend, Mr. Du Noyer, to whose quick and accurate pencil this Academy owes so much, but for whose contributions posterity will yet feel a still deeper debt of gratitude,—inasmuch as he has recorded the present appearances of many places and objects of great interest, fast disappearing,—accompanied me on a hurried visit to the place; and I have to thank him for the field plans and the enlarged sketches of the sepulchral chambers, accurately drawn from measurements, according to the scales appended to each, now before the Academy. On the 16th and 30th of April last, I visited the place, and took rubbings of four engraved stones found in the chambers of cairns already laid open, the curious devices on which I have the honour to submit to the judgment of the Academy.

Commencing on the western peak, I have adopted letters, on the general plan, to denote the cairns.

A—Is twenty-seven paces in circumference, and sixty-three from D. Nearly all the stones which formed this cairn have been removed. Four large stones still remain, standing on the circumference of the base.

B—Is twenty-four feet in diameter, and thirty-eight yards from D. The upper portion of the structure has been removed, laying bare in the centre a long chamber, formed of large flagstones, laid on edge, and pointing in the direction of E. 20° S.

C—Is also about twenty-seven paces round the base, and thirty-five from D. Nearly all the stones have been taken away from the margin and the interior, leaving four large stones standing in the centre.

D—Is entirely composed of dry small stones. The original circle of fifty-four large stones round the base is still perfect, and is 182 yards in circumference. The height of the cairn, in its present state, is about twenty-eight yards from base to summit. The interior of this, the largest of all the tumuli, has yet to be explored. The north and east sides have been left untouched; but on the south and west, for nearly 100 yards round the base, the stones have been almost entirely taken away, extending to a distance of twenty-four yards from the circumference towards the centre. A curve inwards in the circumference of twelve paces in length, indicating the entrance (as shown in those cairns whose chambers now lie exposed), has the direction of E. 20° S.

E—This cairn has been nearly altogether cleared away; about half a dozen of the large stones, apparently used in forming the chambers, still remain. The diameter of the base of the cairn is twenty-one feet.

F—Is about fourteen yards from E, and is fifty feet in diameter; the upper portion removed, leaving exposed the long chamber which formed the grave.

G—Is fifty-four feet in diameter, and forty-three yards from D. Eight large stones remain in the margin, but the upper portion of the pile is gone, leaving exposed in the interior a long grave, having the direction of E. 10° N. Its distance from F is only one yard.

H—Is forty-nine feet in diameter, and is forty yards from I. The long chamber in the centre of this is also exposed.

I—This is the most curious and perfect of all those whose interior chambers now lie partially open. It is forty-two yards from L, and has eight large stones round the base. The direction of the entrance is due east. The interior is circular, as represented in Diagram I., thirteen feet in diameter, and is divided into seven niches by flagstones standing out like radii of a circle; depth not ascertained, as the place would first require to be cleared out. The passage leading in is eight feet six inches in length, and four feet six inches wide, having a stone, nine feet in length, lying opposite to it, and forming part of the circumference of the cairn, which is fifty-five feet in diameter. The terminal supporting stone of the passage on the right hand is in form a rude prism of three sides, standing about four feet high, the face hollowed, and beautifully inscribed with stars, &c., as seen in rubbing.

J—Is thirty-eight feet in diameter, and only four yards from L. Twelve of the large stones which formed its margin still remain. It has been considerably excavated from the top downwards.

K—Is seven yards from L, and forty-two feet in diameter. Thirteen of the marginal stones still remain, and the interior is excavated in top, as in J.

L—Is 136 yards in circumference, surrounded by forty-two large stones, laid lengthwise on their edges. Great quantities of the stones have been removed, but the interior has evidently yet to be laid open. A curve inwards in the circumference, of twenty yards in length, indicates the entrance, which has a direction of E. 20° S. The distance from L to D, the two largest cairns, is 185 yards.

We pass from the western summit; and at the base of the first knoll, before ascending the middle peak, and at the head of a beautiful sloping valley, with several large stones in a line, as if indicating the course of the burial procession as it advanced from the plains, are the remains of three stone circles, close together—fifteen, twenty-two, and twenty-five paces in diameter, respectively,—and evidently the bases of three cairns, whose stones have been found ready at hand for the construction of adjoining walls. Several of the large stones in the circumference have been recently broken up, and carried away.

M—Crowning the first knoll are the remains of a cairn, twenty yards in diameter, at present only about four feet high, and without the usual boundary ring of large stones.

N—On the top of the second knoll are the remains of a cairn, twenty-ten feet high, and ranging from fourteen to thirty paces in circumference, about ten yards distant from one another, on an average, and grouped in a circle. They have been constructed of stones in the centre, covered by about two feet of earth. Fourteen of these only now remain, the others having been torn up for the sake of the stones they contained, and have been used in the construction of an adjoining new fence, running through the sites of some of them, by Mr. W. Stowell Garnet, the owner of the soil. This piece of wanton destruction is much to be regretted, as nothing could be more picturesque than the position of these tumuli, on elevated ground, gradually sloping down to the centre of the circle formed by them, and ending in a round pool of water, sixty paces in circumference. Looking from this spot, are to be seen in every direction numerous raths.

About a mile and a half from Sliabh-na-Caillighe, on the north, stands an engraved stone (see Rubbing 5), in the middle of a large pasture field. The elevation on which it stands is called the King's Mountain; and there is a tradition in the locality that a king was buried under the stone. Being at present used as a rubbing stone for cattle, it could not be expected that the stone should still preserve its original completeness—some pieces are broken off its sides and top. It is seven feet six inches high, three feet broad, and about six inches thick. On its present site, up to a few years ago, stood a tumulus, which the proprietor of the field caused to be carried away for top-dressing. In the centre of the mound was found a chamber filled with bones, and constructed of smaller engraved flagstones, supporting the present upright stone. It is not known what has become of the other carved stones.

The large moats of Diamor, Balgree, Dervor, and Girley are not far distant.

There are also several ancient caves in the immediate neighbourhood. Not far from the base of the eastern peak is that of Belview. The width of the passage at the entrance (see Diagram) is three feet five inches, the height four feet four inches, and the length forty-four feet six inches. The cave then widens out in the form of a circle, whose diameter is thirteen feet ten inches; height of the wall, eight feet up to where the beehive-shaped arched roof commences,—all formed of dry stones, without any cement, and terminating with a large flag on top.

Near the base of the western peak is a still more remarkable double cave (see Diagram). It was discovered about 1824, in the garden belonging to Loughcrew House, by a labourer who was trenching the ground, and came upon one of the large flags on top. The entrance is seven feet below the entrance of the garden, and the common passage from the entrance to the place where it branches right and left is forty-seven yards long, from three to four and a half feet high, and has a slope of two and a half feet for the first nineteen yards; it then rises abruptly two and a half feet, and has a slope of two and a half feet to the end. The continued passage then branches right and left; that on the right being four feet broad, from three and a half to four feet high, with a slope upwards of two and a half feet for ten feet in length, until it turns into a similar passage, fourteen feet long, having a slope or elevation of four feet, and then enters a circular beehive-like chamber, fifteen feet in diameter, eight feet the perpendicular height of walls, and twelve feet in the centre of the cave.

The passage leading to the cave on the left of the common entrance is fifty feet long, goes down on a slope of five feet, is five feet wide, and from two feet nine inches to five and a half feet high. The diameter of the circular cave then entered is twenty feet; perpendicular height of walls, ten feet, and height in the centre of the chamber fourteen feet.

Two similar caves, one on each side of the public road, are to be found near Ballinlough chapel, and one at Balgree.

A little further on, at Clonsilla, are the remnants of three stone cairns, out of which I have been sent some bones, which I submit.

It is very probable that the cairns briefly described form but a very small portion of the number that were once here. The miles upon miles of stone walls, dividing the pasture lands adjoining, bear patent testimony to the use which has been made of these great collections of stones. Even in the lowest part of the valley, between the western and middle peaks, the remains of one (O) are still visible, evidencing the great probability that not only the sides, but even the valleys between the peaks, have been once thickly studded with cairns, similar to those which still remain. I attribute the better state of preservation of those which remain on the western peak to the greater difficulty of removing the stones, owing to the precipitous character of the hill.

Our President has already brought under observation the fact of the raths in Ireland being found running in groups of three. On the western peak, where the cairns are most perfect, there is a striking analogy.

Perhaps the most unique feature in all the cairns of magnitude on Sliabh-na-Caillighe is, that the *entrances* to the interior *are distinctly marked* by a curving inwards of the basement circle of large stones; while at New Grange the entrance would appear to have been carefully concealed, as its discovery is said to be the result of mere accident; and the bearing of these entrances, indicating as it were the very period of the year when the burial took place, at least the first one—for the many chambers would seem to imply that each was intended for a distinct individual.

In submitting the foregoing particulars, I would urge that some steps be taken to have these very interesting remains preserved from further destruction; and that a systematic and careful exploration of this wonderful place should be undertaken by the Academy, asking the cooperation and assistance of the lord of the soil, J. W. L. Naper, Esq., D. L., Loughcrew, whose beautiful residence these interesting relics of antiquity overhang; and whose character for wealth, kindheartedness, and a wish to promote every good object, is well known in the county.

I think, too, that an application should be made to the Ordnance Department to have the entire locality, so fully dotted over with remnants of antiquarian interest, resurveyed, correcting the meagre details they have already supplied and published, and giving on a large scale an accurate mapping of the surrounding neighbourhood, at the same time supplying full particulars.[*]

A discussion having taken place relating to the locality of the ancient remains described by Mr. Conwell, it was—

RESOLVED,—That it be recommended to the Council to make an application to Government to have the hitherto undescribed monuments near Oldcastle surveyed, measured, and mapped.

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, read the following paper :—

NOTES ON ANIMAL MECHANICS.

No. III.—ON THE MUSCULAR MECHANISM OF THE LEG OF THE OSTRICH.

ON the occasion of the death of a fine male Ostrich, during the month of January last, in the Zoological Gardens of this city, I secured the body for dissection in Trinity College, and requested Mr. Macalister, of the Royal College of Surgeons, to avail himself of the opportunity thus afforded of completing the anatomical investigations he had previously commenced in the Royal Dublin Society, by the dissection of a female Ostrich, in the summer of 1863. Mr. Macalister availed himself of the opportunity, and has laid before the Academy such results of his dissections as seemed to him most worthy of record. My own attention was directed especially to the investigation of the muscular mechanism of the leg of the Ostrich, which I have long regarded as one of the most interesting pieces of mechanism in the animal kingdom, and I was fortunate enough to discover, in the digastric *rectus femoris* muscle, what I believe to be the key to the explanation of the complicated muscular apparatus of the Ostrich's leg.

The leg of the Ostrich is to be regarded as a long rod bent at four distinct points, which attains its greatest amount of shortening or bending at the moment the foot touches the ground, and which is suddenly straightened or elongated by the simultaneous contraction of all the muscles. The effect of the sudden elongation of the leg is, to throw the whole body of the bird forward, as if from a catapult, from the point of support of the foot; and while the body of the animal is thus projected through the air, the antagonist muscles that flex the several joints come into play, and are assisted in their action by some very remarkable contrivances in the heel joint, which I shall describe and figure.

It is necessary to the perfection of the mechanism, that the greatest possible amount of muscular force shall be expended in straightening or unbending the legs, alternately projecting the animal from foot to foot along the ground, the leg being at its maximum of flexure at the moment of touching the ground, and at its maximum of elongation at the moment of leaving it; and also, that the minimum possible amount of force shall be expended in flexing each leg, preparatory to its next spring, which must take place on touching the ground.

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[*] The references in the above paper are to drawings preserved in the Library of the Royal Irish Academy.—ED.

I shall show that the leg of the Ostrich fulfils these two conditions of perfect mechanism; but, before doing so, I shall describe in detail the muscles employed in the act of running by the Ostrich.

PART I.—DESCRIPTION OF THE MUSCLES.

1. A muscle, which must be regarded as a combined *tensor vaginæ femoris*, *glutæus maximus*, and *agitator caudæ*, takes its origin from the whole length of the posterior edge of the ilium (and first two caudal vertebræ) forwards to the commencement of the *symphysis iliaca*, *a*, *a*, *a* (Fig. 6), and is inserted as follows:—

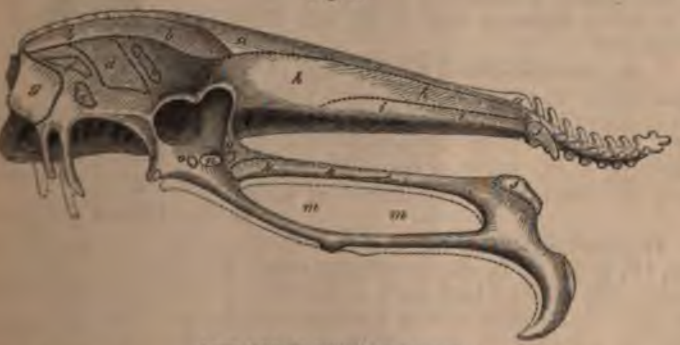
(α). The *tensor vaginæ* portion is inserted into a broad tendon, passing over the outer side of the knee; this tendon forming also one of the origins of the *gastrocnemius*.

(β). The *glutæal* portion of the muscle is inserted, partly like (α), and partly by a muscular slip, into the middle of the *vastus externus*.

(γ). The *caudal* portion of this muscle is inserted into the posterior border of the tendon (α), near the knee: the weight of the whole muscle is . . . . 46$\frac{3}{4}$ oz.

2. *M. glutæus medius* has the origin marked *b*, *b*, in Fig. 6, on the surface of the ilium, and is inserted in the small pit, on the outside of the head of the femur (Fig. 7), and rather behind; its weight is . . . . 13$\frac{1}{4}$ oz.

Fig. 6.



LEFT SIDE OF PELVIS OF OSTRICH.

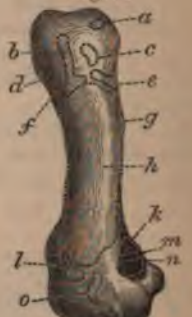
a, *a*, *a*,	Origin of *tensor vaginæ femoris*, *glutæus maximus*, and *agitator caudæ*.
b, *b*, . .	,, *glutæus medius*.
c, *c*, . .	,, *glutæus minimus*.
d, . .	,, *iliacus*.
e, . . .	,, *rectus femoris*.
f, . .	,, *opponens quadrato femoris* (or *iliocapsularis*).
g, . .	Origin of *sartorius*.
h, *h*, . .	,, *biceps femoris*.
i, *i*, . .	,, *semimembranosus*.
j, *j*, . .	,, *semitendinosus*.
k, *k*, . .	,, *adductor magnus*.
l, . . .	,, *pectinæus*.
m, *m*,	. Obturator foramen.
n, . .	. Ischiadic foramen.
o, *o*, . .	. Origin of *gemelli*.

3. *M. glutæus minimus* in the Ostrich is correctly so named, for it is a very small muscle; it arises from a thin line on the ilium, an inch and three-quarters in length, shown at *e*, *e*, Fig. 6, just behind the origin of the *iliacus*, and is inserted, with the *opponens quadrato femoris*, below the great trochanter, on the front of the femur (Fig. 7); its weight is . . . . 1 oz.

4. *M. biceps femoris* has a bony origin, below that of the *glutæus maximus* on the ilium, and lies along the entire surface of the bone, between that muscle and the *semimembranosus*, *h*, *h* (Fig. 6); it is inserted into the tubercle in the middle of the fibula; its weight is . . . 41¼ oz.

5. *M. semitendinosus* takes its origin from the bony prominence of the posterior extremity of the ilium, from the tuber ischii, and the membrane that joins these two points, *j*, *j* (Fig. 6), and is inserted into the inner margin of the upper and posterior surface of the tibia; its weight is . . . . 14 oz.

Fig. 7.



OUTER SIDE OF LEFT FEMUR OF OSTRICH.

a, Insertion of *obturator*.
b, Origin of *vastus externus*, No. 1.
c, Insertion of *glutæus medius*.
d, " *glutæus minimus*.
e, " *quadratus femoris*.
f, " *iliocapsularis*.
g, " *semimembranosus*.
h, Origin of *vastus externus*, No. 2.
k, Insertion of *adductor magnus*.
l, Origin (A, β) of *flexores digitorum*.
m, " (γ), *gastrocnemius*.
n, " (A, α) *flexores digitorum*.
o, " (β) *gastrocnemius*.

A remarkable accessory muscle arises from the insertion of the *adductor magnus* (Fig. 7) in the femur, and is fastened into the tendon of the *semitendinosus*, near its insertion into the tibia. This accessory muscle weighs 1 oz., and runs nearly at right angles to the tendon of the *semitendinosus*. Its action is to lift and guide the tendon, so as to increase the force of the *semitendinosus* in propelling the body forwards when the foot is fixed. The mechanical use of this muscle is similar to that of the *accessorius flexori digitorum longo* in the sole of the human foot.

6. *M. semimembranosus* has its origin on the ilium, below the biceps, as shown at *i*, *i*, Fig. 6; and is inserted in a line commencing at the top of the *linea aspera* of the femur (Figs. 7, 8), and extending to the fascia of the thigh down as far as the inner side of the knee; its weight is . . . . 17 oz.

The similarity of its use to that of the *glutæus* (1) is shown by the circumstance that it sends a slip (1½ oz.) backwards to the sides of the first two or three caudal vertebræ, which must be regarded as an additional *agitator caudæ*.

7, 8. *M. vastus externus* is composed of two parts—

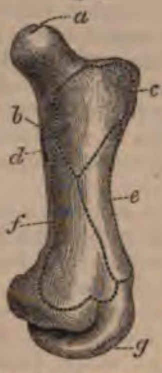
M. v. e. 1. Having an inverted T-shaped origin from the great trochanter, between the insertions of the *glutæus medius* and *minimus* (Fig. 7); it is inserted on the outer side of the capsule of the knee joint; its weight is 25½ oz.

Its action is to the outside of the plane that coincides with the greatest diameter of the highly elliptical cross section of the femur.

M. v. e. 2. Arises from the whole outer surface of the femur (Fig. 7); it has an insertion similar to that of *M. v. e.* 1; its weight is . . . 5 oz.

9, 10. *M. vastus internus*, like the preceding, is composed of two parts, whose origins are shown in Fig. 8—

Fig. 8.



INNER SIDE OF LEFT FEMUR OF OSTRICH.

a, Insertion of *ligamentum teres*.
b, ,, *iliacus*.
c, Origin of *vastus internus*, No. 1.
d, Insertion of *semimembranosus*.
e, Origin of *cruræus*.
f, ,, *vastus internus*, No. 2.
g, ,, *tibialis anticus*.

M. v. i. 1. Arises from the upper and inner surface of the femur, and is inserted into the inner side of the head of the tibia, into the inner edge of the patella and of the ligamentum patellæ; its weight is . . . . 13½ oz.

M. v. i. 2. Arises from the lower portion of the inner surface of the femur, and is inserted into the tendon of the former (*M. v. i.* 1); its weight is . . . . 3¾ oz.

The resultant plane of these two muscles lies as much to the inside of the plane of maximum strength of the femur, as that of the *vasti externi* lies to the outer side of the same plane.

11. *M. cruræus*.—Its origin, which lies altogether on the inner side of the femur, is shown in Fig. 8; it is inserted without a tendon into the patella; its weight is . . . 7¼ oz.

Its plane of moment coincides very nearly with that of the *vasti interni*, just described; and it is almost impossible to avoid coming to the conclusion, that the peculiar elliptical cross section of the femur, and its longitudinal plane of maximum strength, are contrived with reference to the strain of these muscles, so as to enable the slight and delicate structure of the femur (peculiar to all birds), to resist the action of the forces brought to bear upon it, and which exceed in magnitude those acting on the limbs of most quadrupeds.

12. *M. rectus femoris* is not correctly described in any book that I have seen; and its true nature, and connexion with the muscles of the calf, were discovered by me quite accidentally. I had taken for granted, as a matter of course, that the *rectus femoris* terminated in the patella; but, as there were two patellas, I wished to know in which of them the muscle terminated: on dissection, to my surprise, I found that instead of ending in either patella, its tendon passed in a groove over and between them both, and, turning outwards and backwards into the calf of the leg, became provided with a second muscular belly, which formed one of the portions of the *flexor digitorum magnus*, the conjoined tendon of which passed under the heel, and terminated in the plantar surface of the toe.

The *rectus femoris*, with its tendon, is therefore truly a digastric muscle, upwards of five feet in length (Fig. 9), and has its origin in the anterior bony prominence of the ilium, *e*, (Fig. 6), which is well marked on every pelvis of the Ostrich that I have seen. The tendon of this digastric muscle is united to that of the *gastrocnemido-solæus*, by a slip shown at *a*, Fig. 9.

The weight of the fleshy belly of the *rectus femoris* proper is 7¼ oz.

13. *M. sartorius.*—This important and remarkable muscle arises from the anterior portion of the ilium, *g*, (Fig. 6), and from some of the spines of the lumbar vertebræ; and, passing in the usual manner across the inner aspect of the thigh, is inserted into the inner side of the ligamentum patellæ and into the top of the tibia; its weight is . . 18 oz.

14. *M. iliacus*—Has a lozenge-shaped origin on the anterior portion of the ilium, between the *opponens quadrato femoris* and *glutæus minimus*, *d*, (Fig. 6). Its insertion into the femur is shown in Fig. 8, at a point which must be supposed to represent the lesser trochanter; its weight is . . . . 1¾ oz.

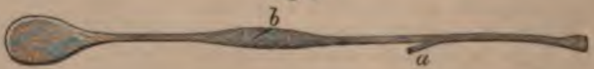
15. *M. gracilis* arises, like the *semitendinosus*, from the tuber ischii, and from the lower half of the ligament joining it to the posterior spine of the ilium; and is inserted into the fascia of the inner side of the knee joint; its weight is . . . . 4½ oz.

16. *M. adductor magnus* arises from the anterior half of the ischial line, *k*, *k* (Fig. 6), and is inserted into the upper margin of the condyloid pit at the back and inner side of the femur (Fig. 7); its weight is . . . . 4¾ oz.

Its fibres were pale and fatty in the specimen dissected by me.

17. *M. pectinæus* arises from the pectinæal point, *l*, (Fig. 6), and is inserted into the tibia on the inner side of the knee, and is intimately connected by muscular fibres with *vastus internus* (2); its weight is 4 oz.

Fig. 9.



DIGASTRIC MUSCLE,

Composed of *rectus femoris**and part of the *flexor digitorum magnus.*

a, Tendinous slip, uniting the tendon of Digastric muscle with that of the Gastrocnemido-solæus.
b, Fleshy line of union with main body of the *Flexor digitorum communis.*

The blending of the fibres of *pectinæus* with those of the *vastus internus*, a portion of which, like this muscle, terminates directly in the tibia, is not to be forgotten in considering the mechanical action of the muscles of the hip and knee joints.

18. *M. quadratus femoris* has an origin on the ischial line, just below that of the *M. adductor magnus*, and an insertion of a linear shape in the back of the upper portion of the femur, shown in Fig. 7; its weight is . . . . 2¾ oz.

19. *M. opponens quadrato femoris.*—This muscle I have so named, because it is met with in many animals as the direct opponent of the

quadratus femoris. In the muscular system of the Ostrich and Lion this antagonism between the muscles is very striking. It is found occasionally in human subjects, and is described by Harrison under the name of *M. ilio-capsularis.* While we had the Ostrich in the Dissecting Room of Trinity College, a human subject was brought in, which had the ilio-capsular muscle fully developed; and my attention was called to it by Dr. Bennett. I have occasionally found the ilio-capsular muscle in dissecting Monkeys.

In the Ostrich, the *M. opponens* has an origin on the anterior surface of the ilium, between those of the *Mm. sartorius, rectus, iliacus,* and *glutæus medius,* as shown at *f*, (Fig. 6); and is inserted in the anterior ridge at the base of the great trochanter, with the *M. glutæus minimus* (Fig. 7), with the fibres of which it is connected; it weighs . . . $1\frac{3}{4}$ oz.

20. *M. obturator.*—In the Ostrich, as in most birds, the internal and external obturator muscles are united, arising from both the inside and outside of the bony circumference of the obturator foramen, and from both sides of the obturator membrane; their common tendon passes through the ischiadic notch, *n*, (Fig. 6), which forms a pulley, changing the direction of the force through 90°, and receives, on emerging from the notch, the fibres of the little *gemelli*, placed at each side, anterior and posterior, to guide the obturator tendon to its insertion (Fig. 7) on the outer part of the top of the femur; it weighs . . . . . $17\frac{1}{2}$ oz.

21, 22.—*Mm. gemelli* weigh . . . . $\frac{1}{4}$ oz.

23.—*M. coraco-clavicularis.*—In the wing of the Ostrich there is a very remarkable muscle, which arises from the bony margin of the coraco-clavicular foramen; this foramen corresponds in the upper extremity with the ischiado-pubic or obturator foramen of the lower extremity; and the muscle, passing under a strap ligament on the shoulder to be inserted in the outer part of the great tuberosity of the humerus, corresponds with the obturator muscle of the leg.

I consider this muscle to be the second pectoral of ordinary birds, and to be the proper *levator humeri.* It is usually placed between the first and third pectorals, on the sternum, and lifts the wing by means of a pulley, which changes its direction through 135°. This contrivance is necessary in birds of flight, in which it is of as much importance to stow the weight aft, as it is in ships to place the foremast well forward; but, as the Ostrich is a running bird, the Divine Contriver has left the second pectoral to lift the humerus by a direct pull, without expending any ingenuity on pulleys to change its direction, as is absolutely necessary in birds of powerful flight such as the Falcon, in which the pulley of the second pectoral is as remarkable a contrivance as the pulley of the obturator muscle in the Ostrich.

In fact, throughout the whole range of the muscular mechanism of various animals, every pulley changing the direction of an original force presents a problem to be solved; and tells us of a contriving mind, which has deviated, for some purpose discoverable by us, from the simple contrivance of muscular fibres pulling directly from their origin to their insertion.

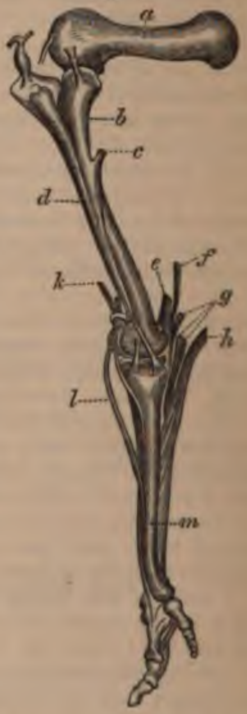
24. *M. gastrocnemido-solæus.*—This great muscle has four distinct heads—

(*a*). From the outer side of the patella and of the ligamentum patellæ.

(*β*). From the external condyle of the femur (Fig. 7.)

(*γ*). From the condyloid pit of the inner condyle, between the *Adductor magnus* and *Flexor digitorum* (Fig. 7).

Fig. 10.



LEFT THIGH, LEG, AND FOOT OF THE OSTRICH.

a, Femur.
b, Fibula.
c, Insertion of *biceps*.
d, Tibia.
e, Tendon of *solæus*.
f, ,, *rectus femoris*.
g, Tendons of *flexores digitorum*.
h, Tendon of *gastrocnemius*.
k, ,, *tibialis anticus*.
l, ,, *extensor digitorum*.
m, Metatarsus, *or* cannon bone.

(*δ*). From the tubercle of the tibia at both sides, and from the surface of the lower patella, and by means of fascia, to the upper part of the fibula.

Altogether it weighs . . . . 115½ oz.

This enormous mass of muscles represents the *gastrocnemius* and *solæus*, intimately connected in their fleshy portion, but distinct both in origin and insertion. It is inserted, as shown in Fig. 10, by means of two powerful tendons into the upper and back part of the metatarsus, the tendon of the *solæus* being a little above that of the *gastrocnemius*.

It may be regarded as acting from the circumference of a ring placed all round the knee joint, to the tendo Achillis; and its resultant pull is nearly in the axis of the leg.

25. *MM. flexores digitorum.*—These important muscles may, in the Ostrich, be divided into two distinct groups:—

A.—This group arises from a triple origin:—
- (*a*). The condyloid pit of the femur, below the origin of the Gastrocnemius (Fig. 7).
- (*β*). From the outer side of the outer condyle of the femur (Fig. 7).
- (*γ*). A fleshy slip connects these flexors with the belly of the digastric *rectus femoris* in the calf of the leg. This slip is represented, cut off at the point *b*, in Fig. 9.

Their total weight is . . . . . 16 oz.

B.—This group has a double origin:—

(*a*). From the condyloid pit of the femur.

(*β*). From the whole back of the fibula and tibia, except that part which is covered by the *poplitæus*.

Their total weight is . . . . $9\frac{3}{4}$ oz.

26. *M. tibialis anticus.*—This is a flexor of the metacarpus, and arises from the two anterior tubercles of the tibia, and from the front of the external condyle of the femur (Fig. 8). It is inserted below the heel joint, by means of a split tendon, into the front of the metatarsal bone, two inches below the joint (Fig. 10). Its weight is . . . . $8\frac{3}{4}$ oz.

27. *M. extensor digitorum communis* (Fig. 10).—This muscle takes a fleshy origin from the tubercles of the tibia, and from the crest in front of the tibia. It is inserted into the toes, and into the annular ligament of the phalangeal joints. It has no action in flexing the metatarsal bone, except perhaps in some unusual positions of the foot. Its weight is . . . . $5\frac{1}{4}$ oz.

28. *M. poplitæus.*—Well marked, and rotates the fibula on the tibia. Weight, ... $\frac{3}{4}$ oz.

Part II.—Action of the Muscles.

In the act of running, the leg of the Ostrich is to be regarded as a jointed lever, having four joints, viz., the hip, the knee, the heel, and the metatarsal joints. As the animal springs from foot to foot, the whole limb on reaching the ground is bent as far as possible at each of the articulations; and when the spring is made, the muscles proper to each joint increase the angle made by the bones meeting at the joint, so that the effect of the whole is to unbend the limb, and give it a maximum of extension at the moment of leaving the ground. During the spring, the antagonist muscles again bend the joints, so that on next touching the ground it is at its maximum of flexion, again waiting to be unbent by the muscles that open the angles of the joint; and so on for ever, as the animal runs, it is thrown alternately from each foot in contact with the ground, as from a catapult, and advances by successive leaps or springs from foot to foot.

To take mathematical account of the moments of the muscular forces round each joint, it would be necessary to make the following measurements:—

Let O and I be the origin and insertion of any muscle, and A the centre of motion of the joint. The effect of the contraction of the muscle is to develope a moment or couple round the point A, acting in the plane OAI, and proportional to the weight of the given muscle, as already shown in Note I. If it be required to find the total effect of the muscles acting on a given joint with respect to any line, AX, we should have to find the angle made by each plane of moment, OAI, with the line AX; and so calculate by the usual rule of composition of moments the total effect of all the forces acting, and tending to produce rotation. Without going into minute detail, and taking only the muscles that act perpendicularly, or nearly so, to the transverse horizontal axis, we find the following muscles to represent the moment of the spring forwards :—

I.—*Muscles extending the Thigh on the Axis of the Body.*

1. Tensor vaginæ femoris,	46·75
2. Glutæus maximus,	
3. Agitator caudæ,	
4. Biceps femoris,	41·25
5. Semimembranosus,	17·00
6. Semitendinosus,	14·00
7. Gracilis,	4·50
8. Adductor magnus,	4·75
9. Pectinæus,	4·00
	132·25

II.—*Muscles extending the Leg on the Thigh.*

10. Rectus femoris,	7·25
11. Vastus externus, (1)	25·25
12. " " (2)	5·00
13. Vastus internus, (1)	13·50
14. " " (2)	3·75
15. Cruræus,	7·25
	62·00

III.—*Muscles extending the Metatarsus on the Leg.*

16. Gastrocnemido-solæus,	115·50
17. Flexores digitorum (A),	16·00
18. Flexores digitorum (B),	9·75
	141·25

The total combined effect of these muscles projecting the body forwards is therefore approximately represented by 335·50 oz. of Ostrich muscle.[*]

After the foot of the Ostrich has left the ground, and during his

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[*] If we knew the weight of the Ostrich, and the length to which it can spring in a single maximum stride, we could easily calculate the work done in a single effort by a given weight of Ostrich muscle. I do not know how far an Ostrich in a state of nature can spring, nor how high, and am therefore unable to make the required calculation; but I give here two corresponding problems for man, which may be interesting to the physiologist.

Problem 1.—A cricket ball, weighing $5\frac{1}{2}$ oz., is thrown a distance of 91 yards; find the work done by the muscles.

The thrower, by practice, finds the angle of maximum range, or 45°; and as

$$R = 2h \sin 2e$$

for the maximum range, h the height due to the velocity of projection is found to be 136·5 ft. This is the height to which $5\frac{1}{2}$ oz. are raised, and therefore the work done is found to be 46·92 lbs. lifted through one foot.

Problem 2.—A young man, weighing 120 lbs., leaps horizontally 20 ft.; what is the work done? By the same method of calculating, we find the work done in this case to be 1200 lbs. lifted through one foot. This large amount of work is not given out in a single spring; for it represents the sum total of the single spring and of the velocity spring through the air, the following muscles are employed in flexing the several joints, so as to have them in readiness for another spring as soon as the foot touches the ground.

I.—*Muscles flexing the Thigh upon the Axis of the Body.*

1. Sartorius,	18·00
2. Iliacus,	1·75

II.—The flexure of the leg upon the thigh seems to be effected by the *vis inertiæ* of the former, when the latter is drawn up towards the body in the spring.

III.—*Muscles flexing the Metatarsus upon the Leg.*

3. Tibialis anticus,	8·75
4. Extensor digitorum communis,	5·25
	14·00

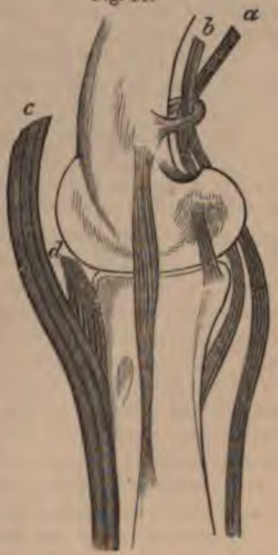
From this it would appear that the moments of the muscles flexing the joints of the limb, during the spring, are represented by 33·75 oz.

This is a small amount of force compared with that employed in extension, and in propelling the body forwards; but the flexor muscles are aided by *inertia*, and by a special contrivance in the heel joint, that remains to be described.

The articulating surfaces of the bottom of the tibia and top of the metatarsus, or cannon bone, are so formed, that it is easier to flex the joint forwards than backwards. This is effected by making the anterior curvature more rapid than the posterior curvature, which produces what connoisseurs in horses would call a beautiful "gig action;" and this natural disposition of the joint is further aided by two admirably contrived check ligaments, shown in Figs. 11, 12, which render the motion forwards much easier than that backwards.

In Fig. 11 I have shown the tendons of *M. gastrocnemius* and *M. solæus;* and in Fig. 12, the tendons of the *flexores di-*

Fig. 11.



INNER SIDE OF LEFT HEEL OF OSTRICH.

a, Tendon of *tibialis anticus.*
b, ,, *extensor digitorum communis.*
c, ,, *gastrocnemius.*
d, ,, *solæus.*

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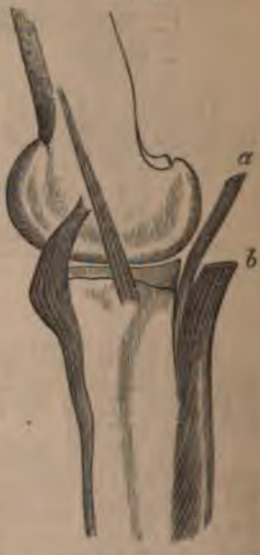
acquired in running up to the point of starting; and the whole art of long jumps resolves itself into jumping vertically with a velocity equal to the acquired horizontal velocity, and making both quantities a maximum.

gitorum communes, passing under and through the tendon of *M. gastrocnemius*.

Fig. 12.



OUTER SIDE OF LEFT HEEL OF OSTRICH.

a, Tendon of *flexor digitorum communis.*
b, " *gastrocnemido-solarus.*

In Fig. 11 are also shown the tendons of *M. tibialis anticus*, and *M. extensor digitorum communis*, passing through a common "dead eye" bolt—a contrivance necessary to keep them in their place on the flexure of the heel joint, and corresponding with the annular ligament of the human foot. In consequence of the arrangements just described, the foot of the Ostrich is jerked forward suddenly, after passing a position of unstable equilibrium, or "dead point," as it is called by mechanical engineers; and is slowly drawn backwards beyond that point by the action of the powerful extensors of the joint, when they are employed in making a spring.

Any observer who examines the gait of the Ostrich, Emu, Cassiowary, or Rhea, in confinement, cannot fail to be struck with the ungainly effect produced on the appearance of the animal, when walking slowly, by the abrupt and odd-looking lifting of the foot caused by the structure of the heel joint, giving an effect like that of string halt in horses; but this unpleasing impression would be rapidly converted into admiration, if he could see the bird in rapid motion over rough ground, springing from foot to foot, and bending the foot as it left the ground with the rapidity of lightning, avoiding skilfully, without an apparent effort, the dangers of the rough soil. I have been informed by eye-witnesses, that under such circumstances the Ostrich in South Africa almost touches the ground alternately on each side with its body, in every successive spring, and leaps with ease over rocks and shrubs of considerable dimensions that lie in its onward path.

I have shown in the preceding part of this paper, that the force expended in propelling the body of the ostrich forward is ten times the force employed in restoring the legs of the animal, preparatory to its next spring; more exactly, as 335·5 to 33·75. This enormous force acts upon bony supports, which are required by the necessities of a bird's existence to be as delicate and light as possible; and it is, moreover, exerted almost instantaneously, so as to give the fullest effect to the bird's spring. The question naturally arises, how is this force to be suddenly applied, without breaking or dislocating the animal's legs?

The answer to this question is to be found in the peculiar structure of the *rectus femoris* muscle, which binds down the patellæ, straps up the heel, and brings the whole machine into harmony at the moment that the spring is about to take place.

The admirable mechanical economy of the leg of the ostrich may be illustrated by the parallel case of the Cornish pumping engine. Let us suppose a 100-inch cylinder engine about to commence its downward stroke, and to lift the pump rods, weighing many tons, by means of a force of steam which commences at a maximum, and is gradually let off by expansion to a safe and manageable quantity. It has been found by experience that it is necessary to cause a minute vibration of the beam before letting on the full force of the steam—such vibration shaking all the nuts and pins into their proper positions before the great and sudden action of all the parts takes place; and if such a precaution were to be omitted, it is well known that the sudden impulse of the steam would break the engine.

In the leg of the ostrich, the *M. rectus femoris* supplies the place of the preliminary vibration; it acts before the extensor muscles come into full play; it binds down the two patellæ, braces up the heel joint, and gives the signal for the *M. gastrocnemido-solæus* and other associated muscles to contract, and thus produces what may be regarded as one of the most striking phenomena in nature, viz., that the delicate bones and ligaments of a bird's leg, acted on by muscles equal to those influencing the hind leg of a horse, shall remain uninjured under the sudden action of forces, the slightest error in the application of which would break to pieces the machine on which they act.

I can admire, though I do not envy, the reasoning powers of those Naturalists who believe that a mechanism such as this grew out of pre-existing forms without the interposition of an intelligent mind; and for myself I must declare, that I could as easily believe that the modern Cornish engine had developed itself from its clumsy predecessors by the way of Natural Law, and without the interposition of intelligent engineers, as that the leg of the Ostrich was produced by Natural Selection from the commonplace legs of its less perfect ancestors.

MONDAY, JUNE 13, 1864.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

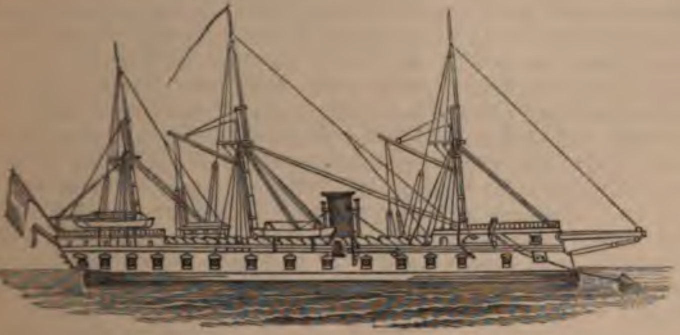
G. C. GARNETT, M. A., read the following paper :—

ON ARMOUR-PLATED SHIPS OF WAR.

THE first ships of war that were plated with iron were designed and constructed in America. Mr. Stephens, the designer and builder of some of the fleetest and most beautiful ships and steamers in the American marine, made, in 1845, a series of experiments at the expense of the American Government, to ascertain the resistance of iron plates to shot and shell. The result then arrived at was, *that plates less than an inch in thickness would resist the impact of any shell then known ; and that a thickness of six inches of iron was impenetrable to every projectile that was brought against it, no matter how great the velocity, or how short the distance at which it was fired.* These results were duly communicated to the learned societies in both London and Paris. Here indeed they fell, as Sir Howard Douglas observes, on stony ground. In France, however, the result was different; for the powerful and energetic mind of the Emperor Napoleon was not long in perceiving the immense advantage of these results. Accordingly the French Government proposed, at the commencement of the Crimean war, that a class of vessels should be jointly constructed by the two governments : of these six were built in France, and six in England. These were of the class known as floating batteries. Ours, indeed, were not ready until the Russian war was concluded, and have never seen service, if we except the " Trusty," against whose sides we are daily trying the force of spherical and conical projectiles, and as yet without having obtained any settled result. They are, however, a class of vessels little suited for their intended purpose, being wall-sided, and presenting at both bow and stern a flat surface for shell and shot, but, as far as the English batteries are concerned, must for sea going purposes be deemed a failure.

" La Gloire" is built of wood, and is much stronger than is usual in our corvettes, or even in our frigates, being built, as Scott Russell, Esq., F. R. S., observes, on the model of the French line of battle ships, "Algesiras" and "Napoleon," each of 90 guns, whereas "La Gloire" only carries 40 ; her tonnage registers 3000 tons, and her actual displacement is 5000 or 6000 ; the dimensions are as follows :—Length, 250 feet; beam, 55 ; her maximum speed is 13·375 knots ; and she is coated from three feet below the water line with $4\frac{1}{2}$ inch good hammered iron. But perhaps the most curious circumstance connected with "La Gloire" is, that when she was building it was predicted that she would never be able to carry in a seaway her armour plating, much less her heavy ordnance.

Being constructed by Mons. Dupuis Délôme, one of the most intelligent naval architects of the age, it seemed rather surprising indeed, to some, that he should have made so gross a miscalculation; and indeed experience verified their belief, for she was found to answer when at sea all that was required of her, even in the worst weather. Yet, as Mr. Russell observes, she must not be viewed as her builder's "chef d'œuvre:" she was no doubt built to suit the capabilities of the French dockyards—an abundance of wood, and but little iron. Had her builders possessed the resources of England, the probability is, her construction would have been at least modified. The following is a true representation of this fine frigate, taken expressly for this paper, by Lieutenant Peile, R. N. R.



No doubt a great part of the stability depends on the materials of the hull being composed of the same or of different materials. In my opinion all iron is by far the most serviceable, yet I know that to this theory I have many opponents. General Sir Howard Douglas says, in support of iron bottoms:—"In spite of their horror of iron, the Admiralty ought to have discovered before this time that, *even* if the top sides of a man of war should be of wood, the bottom or water portion should be of iron; for it has been found in almost every case where one of our screw liners was driven at even the moderate speed of 10½ or 11 knots, the seams opened and the caulking escaped, and this indeed seems to be one of the strongest objections to converting old wooden vessels into demi-iron ships of war, such as the 'Royal Oak.'" From a Parliamentary return, dated 4th of May, 1863, in reply to a motion of Sir James Elphinstone, it appears that there were built, and building, eleven iron and ten wooden iron-clad ships of war, and the seven floating batteries, of which *three* have never been commissioned; and two, though sent on foreign service in a supposed efficient state, have cost the nation £3571 for repairs to the hulls, which expense indeed is not to be wondered at, when we find the "Thunderbolt," one of the batteries, ***has never been*** *commissioned*, though launched on the 22nd of April, 1856, yet has cost no less a sum than £1291 for repairs to the hull. *Vide* Return to the Honorable House of Commons in reply to Sir James Elphinstone, dated May 5, 1863, No. 237.

In reference to the cost of these iron-cased frigates, we find that in the return made on the motion of Captain Jervis the total cost of the "Black Prince" was £373,899, of which the engines cost £74,449, the hull and rigging, £272,729, the balance being for alterations; while for adopting Griffith's screw propeller a sum of £156 is acknowledged. The "Resistance" and "Defence" have cost £257,848, and £252,898; while the "Warrior" even exceeded these charges, large though they seem, her total cost, according to these dockyard returns, being £377,373—a sum that in "the days of old" would have been amply sufficient for two three-deckers and a 36 gun frigate.* Yet the question is not one of mere money: if the article contracted for was supplied, then there would be little cause for complaint, but in nine cases out of ten this is not the case. It is a matter of extreme difficulty to produce a ship of 400 feet in length with sufficient strength to stand heavy diagonal and transverse strains. Mr. Fairbairn, indeed, has investigated the relative strength of iron bars and plates; and he shows that the cohesive power or strength of bar iron may fairly be taken at 25 tons, or 56,000 lbs. per square inch of section; with bars of $\frac{1}{4}$ inch each of Yorkshire, Derbyshire, Shropshire, and Staffordshire iron, he obtained a mean breaking weight across the fibre of 21·350 tons per square inch. The Shropshire plates were the best, breaking under a strain of 22·826, while the rest barely averaged 19·563.

The cost of all iron vessels is greatly increased by the corrosion, or rust, of the material; to counteract this fatal tendency various means have been employed. There are two materials or paints in use in the British navy—one known as Hayes', and the other as M'Innes', composition—their object being, in company with a number of others, to limit as far as possible the tendency to "oxidation." Monsieur Jean Pierre Jouvin, Professor of Chemistry to the French Navy, has patented an invention of a somewhat novel description. It consists of laying sheets of zinc against the ship's sides, and between the hull and frame; and in case of the vessel being *already* built, coating the frame, and what portion of the hull can be reached, with a strong solution of zinc paint. The zinc sheets vary from $\frac{1}{16}$ inch to $\frac{1}{32}$ inch thick, while the ribs, keelsons, clamps, transversal bulkheads and all other parts not covered with these zinc sheets, are coated with a powerful solution of the metallic zinc paint. For the outside of the hull, however, this provision would hardly answer, therefore Mons. Jouvin coats it with composition composed of the following: Turbith mineral ($SO_3 3HgO$), mixed with Prussian blue ($3Fe\,Cy + 2Fe^2 Cy^3$), producing by its contact with the "*alkaline chlorides*" of sea-water one of the most violent poisons known to mineral chemistry, viz., the *cyanide of mercury* ($HyCy$) in the shape of chloro-cyanide of mercury and sodium. He therefore first mixes 55 parts of turbith mineral and 45 parts Prussian blue, and composes the paint as follows:—Boiled linseed oil, 250 parts; red lead, 679 parts; and the aforesaid mixture, 100 parts; but this mixture must not be applied to the bare hull, which on the contrary must first receive a coating of zinc paint of not less than $\frac{1}{16}$ inch in thickness. I believe, of all the various compositions invented for the purpose, this of M. Jouvin to be the best.

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* Mr. Bidder, one of our most eminent engineers, has pronounced the "Warrior" in every respect a failure, save one—that she, under certain circumstances, is a fast vessel. Admiral Sir George Sartorius has also borne similar testimony—the vessel steering badly, and when she took a sheer, no action of the helm could stop her. She is also very leewardly, and rolled more than any line-of-battle ship.

The metal Mr. Whitworth uses in the construction of his ordnance is known as homogeneous iron, very much of the same nature as mild steel. It is chiefly composed of bars of Swedish iron, cut into short lengths, melted in crucibles, and cast into a large cylindrical ingot, which is subsequently forged under a tilt hammer into the required form. The guns are forged solid, bored out in the usual manner, and rifled uniformly throughout their length, without leaving any chamber at the breech end. The pitch in the rifling of a 12 pounder is one turn in 60 inches. Mr. Whitworth's favourite projectile is a "flat-headed"* hexagonal bolt. To give an idea of its force, it may be stated, that when it was fired at the "Alfred" target ship at Portsmouth, the gun being laid at 450 yards, the shot passed through 30 feet of water diagonally, and eight inches of oak, piercing the timber three feet below the surface of the water; when spherical shot, or long projectiles with rounded fronts, are fired in the water, they do not penetrate below the surface, but turn and come back again; the flat-fronted shot seems the best for traversing iron plates. If the round-fronted form of shot is fired against a thick wrought iron plate, it displaces the particles of the iron plate in a lateral direction, and has to overcome the great lateral resistance they offered to its passage. In the case of the flat-fronted shot the resistance is confined to the exact spot on which the flat front of the shot strikes, the resistance then becomes *direct*, and not lateral; and if the "momentum" of the shot is sufficient, it displaces the particles of the iron plate, and forms a vacuum in the shape of a round punched hole. With regard to the question of rifling the bores of guns, which seems to be generally assumed as an indispensable theory in these days, there are many opinions. Mr. Adams regards it as simply a contrivance for correcting the defects of badly constructed projectiles at a considerable waste of propelling power. If the centre of gravity of a conical shot is not placed at the junction of the major and minor axes, the resultant of the curve will be in a waved form. And as it is a mere matter of chance where the *bias* of a projectile may be in a gun, it is uncertain where the shot may fly to. The spinning motion in a great measure counteracts this; and with elongated shot, as commonly made, not only might the centre of gravity be out of the line of the central axis, but almost invariably, when made with its sides parallel, and with a conical point, it would, when placed in the gun, have the centre of gravity behind the middle of the length; therefore, on leaving the gun, it would try to turn over, to get the *heavy* end foremost, and it is in a great measure to counteract this that rifling is an advantage.

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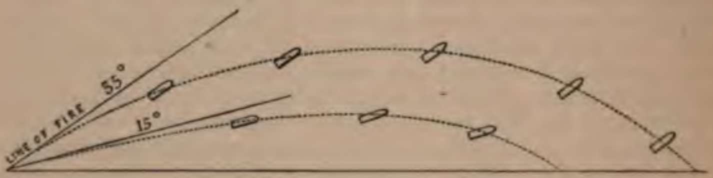
* This kind of shot is said to have been used with great success by the captain of a whaling ship, to kill seals, many years ago.

One of the chief obstacles to high angle firing (in the case of conical shot), is the fact of the major axis of the cone always keeping a constant angle in all the points of its trajectory. In the diagram given below, it will be seen that both in the case of an angle of 35° and 15° the axis (major) remains parallel to its original elevation. This is of the utmost



importance in "target practice;" for if the angle became, say 45°, the axes would become parallel to the face of the target. The impact would then become oblique, and the resistance of course greater in the ratio of the axis of the cone to the axes of the common round shot; this impact, in several of its properties, is but indifferently known. The flame at the moment of concussion, now so generally observed, is the subject of great controversy. Is it the destruction of force? or is it the carbon evolved at impact by condensation of the molecules, which, mixing in the atmospheric oxygen, are fused by the heat generated by the concussion? It is true that the experiment of letting fall balls of iron from a great height into a well has had the effect of visibly raising the mercury in the thermometer; yet this heat is incapable of combustion, being at too low a temperature. Some think it to be the compression of the atmosphere to such a degree as to produce solidity, and in that state to evolve electrical properties. One thing remains certain, its appearance in almost every case where steel shot, or shell, is fired against a resisting substance of iron. Would it not be possible to measure its intensity by means of a thermetrical index attached to the target? Professor Tyndall, F. R. S., has shown that heat generated by impact increases as the square of the velocity, so that the heat of impact increases in the same ratio as velocity is augmented. Now, the velocity imparted by gravity to a body falling through a space of 772 feet is 223 feet per second; six times this, or 1338 feet per second, would not be an inordinate velocity for a rifle ball; but if this ball was composed of lead, this velocity would raise its temperature 30°; with six times this velocity, its temperature would increase about 36 times, or 1080°, with a velocity 1338 feet per second, quite sufficient to fuse the lead if concentrated in the ball itself; but the fact is, it is divided between the target and the projectile, and in the case of the iron projectiles only one-fourth of this amount, or 320°, would represent the heat. Mr. Joule, of Manchester, has shown that if indeed all this heat in the target, after concussion, and in the projectile, and latent in the gun itself, were combined, the force represented would be sufficient to propel it back along the projected trajectory into the gun again. The concussion produced by these heavy pieces of ordnance is very great; and the lateral and longitudinal strains on the timber of the ship, such as to render the stability of the vessel a fact of the greatest importance: the vertical line being in a state of fluctuation produces an immersion, and consequent emersion, greater or less according to the stability of the vessel. Mr. Peake has shown that the height of the metacentre above the centre of gravity of displacement of the immersed portion of the body may be represented by the following formulæ* :—

$$mG = \frac{GF}{\sin\theta} = GF \div \sin\theta = \frac{2}{3}\int\frac{y^3 \times \sin\theta \times dx}{D} \times \frac{1}{\sin\theta} = \frac{2}{3}\int\frac{y^3 \times dx}{D};$$

from which we deduce

$$\frac{2}{3}\int\frac{y^3\,dx}{D},$$

a formula of great practical benefit in calculating the relative stability of floating bodies.

Baron Sané and M. Tupinier used the following formulæ for the relative values of the contents of the parallelepipeds of his famous 18-pounder frigates and "La Guerrière," an old 36-gun French frigate:—in "La Guerrière,"

$$x : L :: y : l :: z : h :: \sqrt[3]{N} : \sqrt[3]{P} :: \sqrt{\frac{M}{R}}\,\sqrt[3]{\frac{V}{r}};$$

$$\therefore x = L\sqrt[3]{\frac{M.r}{V.R}};\ y = l\sqrt[3]{\frac{M.r}{V.R}};\ z = h\sqrt[3]{\frac{M.R}{V.R}}.$$

---

* This determines the height of the metacentric point (m) above the centre of gravity (G) of the displacement.

In 18-gun frigate, " La Gloire,"

$$x = L' \sqrt[3]{\frac{M \, . \, r'}{V' . \, R}}; \; y = l' \sqrt[3]{\frac{M \, . \, r'}{V' . \, R}}; \; z = h' \sqrt[3]{\frac{M \, . \, r'}{V' . \, R}},$$

and finding means for $x \, . \, y \, . \, z$. (length, breadth moulded, and depth), of immersed body, we get

$$x = \sqrt{LL' \sqrt[3]{\frac{M \, . \, r}{V . \, R}} \cdot \sqrt[3]{\frac{M \, . \, r'}{V' . \, R}}} = \sqrt{L \, . \, L' \sqrt[3]{\frac{M^2 . \, r \, . \, r'}{R^2 . \, V . \, V'}}}$$

$$y = \; . \; . \; . \; . \; . \; . \; . \; . \; . \; \sqrt{l \, . \, l' \sqrt[3]{\frac{M^2 . \, r \, . \, r'}{R^2 . \, V . \, V'}}};$$

$$z = \; . \; . \; . \; . \; . \; . \; . \; . \; . \; \sqrt{h \, . \, h' \sqrt[3]{\frac{M^2 . \, r \, . \, r'}{R^2 . \, V . \, V'}}};$$

$$\left.\begin{array}{l} L = \text{length on water line;} \\ l \;= \text{breadth, moulded;} \\ h \;= \text{mean depth of immersed body;} \end{array}\right\} \text{" La Guerrière."}$$

$$\left.\begin{array}{l} x \\ y \\ z \end{array}\right\} = \text{ditto, 18-gun frigate.}$$

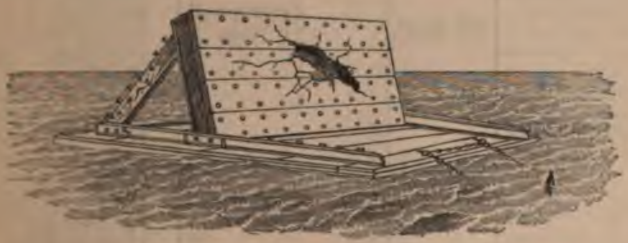
V and M, solids immersed.

N, content of the parallelepiped described about the immersed body.

$$\text{Ratio between these last two solids} = \frac{M}{N} = R,$$

M and R being the only variable quantities.

On the 11th of December, 1863, Sir William Armstrong's " Big Will" was fired at Shoeburyness, and with what results will be seen. This piece of ordnance weighs $22\frac{1}{2}$ tons. It is what is technically termed a built gun, being composed of eight coils of metal. It is rifled with ten grooves on the shunt principle, and the shot is made to rotate by means of ten rows of gun metal fitting into these grooves; each row contains five stems, and these stems, being made of softer metal than the grooves, do not injure it; the gun is fifteen feet in length, and the internal diameter is $13\frac{3}{10}$ inches, and the external diameter at the muzzle one foot nine inches. At ten degrees elevation, the range is no less than 4000 yards. The average weight of the shot is 600 lbs., and these are divided into three kinds—the first solid, 510 lbs.; the second hollow, for a bursting charge; and the third, a segment weighing 600 lbs. This is composed of a thin case, similar in form to that of a common shell; inside this case is built up a series of loose pieces of iron, so constructed as to form a series of rings from bottom to top; these segments number 510 pieces, each weighing six ounces; a time fuze is set on the top of the shell, which communicates with the bursting charge, fifteen pounds of powder inside the shell. After "Big Bill's" trial against the "Warrior target," the target itself underwent a strict scrutiny. The target was found fractured in every direction in radiations from the oblong aperture or rent, which was two feet long, and one foot eight inches wide in front, a couple of inches from the circular white sight, as shown in the accompanying engraving. The three-fourth inch iron backing was found torn away in long slips: the sight, indeed, when the target was struck by the shell, is said to have been very grand. The shell is said, from its enormous size, to have been distinctly seen during its entire flight of 1000 yards; and at the moment of impact volumes of smoke burst from the target, accompanied with sheets of flame.



Experiments with the "Warrior" Target.—The experiments at Shoeburyness have done much to elicit the respective merits of the various guns, and the different constructions of targets. In these trials, the breech-loader was withdrawn by Sir W. Armstrong. Excellent, no doubt, as a shell gun against wood, it does not possess that penetrating power to become a formidable antagonist against armour-plating. Originally intended to be fired with 14lbs. powder, this charge was further reduced to 12 lbs., and again reduced to 10 lbs., which is about what the weight of the gun, 60 cwt., is able to bear. The weight, and bore, and charge of the two competing 70-pounder guns were as follows:—

TABLE *a*.

Description of Gun.	Bore.	Weight.	Charge.	Bursting Charge of Shell.
Armstrong shunt, 70-pounder, . .	6·5 in.	75 cwt.	14 lbs.	2 lbs.
Whitworth 70-pr., .	5· „	76 „	12 „	1 lb. 14 oz.
	Range—800 yards:			REMARKS.
	1st round, .	. . .	Solid steel shot, .	*1st Round.*—Whitworth hit middle part of armour plate ("Warrior," 4½ in.) and 18 in. teak, and penetrated its own depth (18 in.). Rear end of shot broke off, and flew out. Shunt missed.
	2nd Round,	. . . .	Solid steel shot, .	*2nd Round.*—Whitworth, penetration as before. Shunt drove in 4½ in., burying, but not quite penetrating. Shunt missed.
	3rd Round,	. . . .	Steel shell, .	*3rd Round (Shell).*—Whitworth drove in 4½ in. Shell exploded, scattering fragments in front of the target. Shunt gun indented 2½ inches, and burst.* Pieces not found.
	Range— 50 yards:			
Whitworth 70-pr. (with hexagonal shot); solid steel; 12 lbs. powder, .	. . . . .	. . . . .	. . . . .	Penetrated 10 in.; head of shot split.
Armstrong shunt 70 pounder; spherical steel solid shot, weighing 34 lbs.; fired a wooden sabot, and 18 lbs. powder, .	. . . . .	. . . . .	. . . . .	Rear end of shot about 3 in. below surface of plate, which was penetrated, and broke up.

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* The pieces of this shot were found next day 500 yards in front of the target, and almost in a line with the battery. This happened more than once; and it becomes evident that steel shells which divide in two parts annularly, instead of shattering into fragments, may become highly dangerous to the parties firing them, in cases where they do not penetrate.

TABLE β.

Description of Gun.	Bore.	Weight.	Charge.	Bursting Charge of Shell.
Armstrong shunt, 70-pounder, . .	6·5 in.	75 cwt.	14 lbs.	2 lbs.
Whitworth 70-pounder, . .	5· „	76 „	12 „	1 lb.
	Range—600 yards:			
	1st Round,	. . . .	Steel shell,	*1st Round.*—Whitworth lodged in the middle of plate, leaving rear protruding 4 inches; penetration 9⅛ inches, in an oblique line. Shunt gun tore face of plate, and lodged.
	2nd Round,	. . . .	Steel shot,	*2nd Round.*—Whitworth entered plate and burst, destroying the teak backing. Shunt indented target 1⅝ in. Shell exploded, and pieces retrograded in a line to the battery, to a distance of 350 yards.
	Range—50 yards:			
	1st Round,	. . . .	Steel shot,	*1st Round.*—Whitworth penetrated 6 inches. Head of shot split. Shunt gun imbedded, slightly tearing the surface of iron.
	2nd Round,	. . . .	Steel shell,	*2nd Round.*-Shunt drove in plate 10 inches, and rebounded 17 yards (not burst). Whitworth entered 4½ in., then burst, driving out teak backing, and tearing away the bolts.

The shell appears to have exploded *just* as it entered the timber backing, and it made a hole four times greater in the rear than in front. The upper plate was driven out from its supports, and the rivets broken. The bursting charge was 24 lbs., and the gun charge 70 lbs. The following is a table of the firing:—

I have been informed by an officer of the Royal Horse Artillery that at 2½° the range of the Armstrong 9-pounder with 1 lb. 2 ozs. powder (charge) has a mean velocity of 955 feet per second.

The above are some of the results of the experiments made with the Armstrong and Whitworth guns, by J. A. Longridge, Esq., C. E. In all these cases the actual range is far below the range *in vacuo*, or the parabolic range.

Mr. Whitworth's shell is well known to have high penetrating power. A series of experiments are detailed in Sir James Emerson Tennent's "Story of the Guns." Its possessing *no fuse* has, indeed, been deemed a novelty; yet so far back as 1848 the French frigate "Psyche" possessed shells of a similar nature, invented by Capt. Billette, of the French navy. They were fired from the ordinary service guns of a large calibre (84-pounder). It is said to have been used with disastrous effect by the French at Mogador, in 1844, and subsequently at Algiers. If let fall from the upper to the lower deck, no accident is said to have resulted. Its combustion was, it is said, caused by the heat generated in its passage through the atmosphere, after attaining a given velocity. The following is a table of comparison between the Whitworth and Armstrong 12-pounder:—

TABLE ζ.

Description of Gun.*	Elevation.	Actual Range.	Initial Velocity in Feet per Second.
	Deg. Min.	Yds.	
Whitworth 12-pounder, . .	2 0	1252	1300
Armstrong 12-pounder, . .	1 15	840	1080

This would give the difference in the parabolic range, allowance being made for the inequality of level, of and durability, combined with a moderate amount of wear. That the breech-loaders are most properly abandoned is now an admitted fact. The cost of the old 8-inch cast iron guns was about £100, while the cost of a similar breech-loader is about £800, while the initial velocity has been proved by H. M. S. "Excellent's" practice to be very inferior to that of the muzzle-loaders. The mean velocity of a 49 lb. shell, fired from a 32-pounder rifled service gun was shown to be 1120 feet per second, with a range of 1600 yards, while 826 feet per second is the mean initial velocity of a breech-loading field service gun. Guns, it must be admitted on all sides, will have an advantage over ships, as there is no *absolute* restriction to the size of the gun, though there is to the size and weight of the armour-plates of the ships. That great desideratum—"stability"—seriously affects all our iron-clads, and is a fault that can only be rectified by the loss of a great portion of that armour plate that renders them "invulnerable" (?).

In the calculation of the effect of any explosive agent, due regard Mr. Longridge observes, must be given to the evolution of the permanent gases. Captain Boxer, R. A., in his valuable treatise on Artillery, computes the gases evolved from one cubic foot of gunpowder when reduced to ordinary temperature to be

Nitrogen, ... 79·4 cubic feet,
Carbonic acid, ... 238·0 „

or, according to Mariotte's law, a pressure of 317·4 atmospheres. This pressure may indeed be estimated by this law, represented by the equation to an adiabatic curve—

$$p \propto \frac{1}{v^k}, \quad \text{or} \quad \frac{p}{p'} = \left(\frac{v'}{v}\right)^k.$$

Here p and p' are the pressures before and after compression; v and v', the volumes corresponding; k, the ratio of the specific heat at constant volume to that at constant pressure. In the case of air, $k = 1\cdot41$; and if this be the same for carbonic acid and nitrogen, the pressure after compression $= 317\cdot4$ atmospheres,
$= 3\cdot367$ „
$= 22\cdot17$ tons per square inch.

In estimating the initial force of gunpowder from the velocity as ascertained by the ballistic pendulum, the usual method is that of Dr. Hutton, to find the value of n in the formula :—

$$v = 47\cdot4 \sqrt{\frac{nhd^2}{p+w}} \cdot Log\frac{b}{a};$$

from which we obtain

$$\frac{n = (p+w)v^2}{\overline{47\cdot4}|^2 hd^2 \, Log\frac{b}{a}}.$$

Now, Dr. Hutton obtained from this formula the value of $(n) = 2 \cdot 400$ atmospheres, or $15\frac{1}{2}$ tons per square inch. The result, as Mr. Longridge observes, is far from accurate: as the variation of pressure must be allowed for Mariotte's law, by adopting the true thermo-dynamical law, we have

$$n = \frac{(p+w)v^2}{\overline{47 \cdot 4}|^2 d^2 \dfrac{h^k(a^{1-k} - b^{1-k}}{k-1}};$$

or, applying it to Mr. Whitworth's 80-pounder, with a velocity of 1300 feet per second, a pressure of 24·58 tons per square inch.

For the different equations for the velocity of the centre of oscillation, Dr. Hutton deduced the formula—

$$\frac{biv}{pg + bi} = \frac{5 \cdot 6727\, c}{r} \sqrt{\frac{pgo + bii}{pg + bi}},$$

from which equation we get

$$v = \frac{5 \cdot 6727\, c}{bir} \sqrt{(pgo + bii) \times (pg + bi)},$$

the *true* expression for the original velocity of the ball, *before* it strikes the pendulum, by extracting the root of the compound factor,

$$(pgo + bii) \times (pg + bi),$$

we have

$$pg + bi \,.\, \frac{o + i}{20} \times \sqrt{o},$$

a formula *within* the $\frac{1}{100000}$ of the *true* value, from which the value can be estimated.

$$v = 5 \cdot 6727\, gc \,.\, \frac{p + b}{bir} \sqrt{o}\,.$$

The speed of most iron-clads, strange to say, is, notwithstanding the immense weight of their superincumbent armour, superior to the expectations of their designers. The greatest speed yet obtained has been that of the "Achilles;" this vessel obtained a speed at full boiler power of sixteen knots. The "Warrior" obtained a speed of $13\frac{1}{3}$ knots at a mean draught of $26\frac{1}{2}$ feet, completing her circle in eight minutes and thirty seconds, while the "Mersey" took forty minutes; one of our crack 3000 ton frigates took no less than eleven minutes and fifteen seconds to do the same. The length of the "Mersey" is 287 feet $15\frac{1}{15}$ inches, and that of the "Warrior" 383 feet $2\frac{2}{5}$ inches, which makes the "Warrior's" superiority the more remarkable, and proves that a long ship can answer the wheel as well as a short one; but in stability little can be said for vessels of the "Warrior" class. The index pendulum on the wheel standard gave a registered immersion and emersion of 15° starboard, and 12° port; and there is little doubt but that in a gale of wind the deflection will be considerably more, as when the above deflections were registered the weather was moderate. No doubt exists of the want of stability in vessels of the "Royal Sovereign" class, when the weight of the turrets is considered—130 tons, and the 5½ inch armour plate. The plan adopted, also, of transforming old wooden liners into iron cupola ships, is evidently erroneous,—the timbers of these ships not being able to withstand the strain of the increased weights; their ponderous turrets also are most objectionable,—liable, on the one hand, to get out of order, from failure or injury of the revolving machinery; and, on the other, to become rapidly choked with smoke. They oxidize to a great extent, and once strained out of the vertical line are incapable of rotation. In order to substantiate the above theories we have many American testimonies. I cannot but state a few of the most remarkable here, quoted from authentic sources.

The official reports of the commanders of the Monitors, or turret-ships, made immediately after the failure of the attack upon Fort Sumter in April, 1863, tend to show that these vessels are incapable of resisting the concentrated fire of heavy rifled ordnance. Capt. Drayton, of the "Passive," says:—"The ship was struck in quick succession in the lower part of the turret by two heavy shots, which bulged in its plates and beams, and, forcing together the rails on which the carriage of the 11-inch gun revolved, rendered it wholly useless for the remainder of the action. A little after a very heavy rifled shot struck the upper edge of the turret, broke all its eleven plates, and then, glancing upwards, struck the pilot house with such force as to send it over, open the plates, and squeeze out the top, exposing the inside of the pilot house, and rendering it useless." Capt. Rogers, of the turret-ship "Weehawken," says:—"Two or three heavy shots struck the side armour near the same place; they so broke the iron that it only remained in splintered fragments, much of which could be picked off by the hand, and the wood exposed; the iron was five inches thick. The 'Petapsco' was disabled, and the 'Nantuck' and the 'Nahant' had the iron stripped from the wood, their sides bulged in many places, and several holes in the turrets. Their armour plates on the cupolas were disconnected, and the rivets broken; and before the close of the action the 'Weehawken' had shot-holes in her sides so low down, that the water ran into the ship in streams." Such is the published American account of their iron-clad cupolas in action, and it can hardly be hoped that our turret ships are by any means capable of performing with more satisfactory results.

There seems every probability that gun-cotton will in a great measure take the place of gunpowder in iron-cased ships. In Austria it has already done so. It has, no doubt, *disadvantages*, yet from recent experiments it would seem that these were counterbalanced by certain properties of most beneficial tendency. Xyloïdine, first discovered by M. Braconnot, bears a certain affinity to the pyroxyloïdine of Professor Schœnbein; yet the former is essentially different in its composition, and has been proved to be unsuitable for firearms. John Hall Gladstone, Esq., of University College, London, has shown that by combustion with oxide of copper in a stream of oxygen, the following results were obtained:—

	Grains.
Cotton employed,	8·16
Carbonic acid produced,	5·14
Water produced,	2·06

These proportions are:—

Carbon,	44·37
Hydrogen,	7·24
Oxygen,	48·39
	100·00

Lignine, calculated from the formula, $C_{24}H_{20}O_{20}$:—

Carbon,	44·44
Hydrogen,	6·17
Oxygen,	49·39
	100·00

Now, this cotton, which may, observes Mr. Gladstone, be considered as a pure lignine, was steeped in nitric acid, spec. grav. 1·502, with nearly an equal bulk of strong sulphuric acid, and dried at a temperature not exceeding 212°. This composition exploded at a temperature of 370°, producing *no smoke*, and *leaving no residue*. Acetic acid at once destroys its fibre; chloroform apparently does so to a certain degree; yet, if the collodion formed is viewed microscopically, the disentegrated fibre will be seen to reunite atomically, a fact first mentioned to me by Dr. Carte, Curator of the Museum, Royal Dublin Society. Professor Barker has also informed me that he found it to explode, over a hot water bath, at 212°.* The formula $C_{24}\left\{\begin{matrix}H_{15}\\ 5\,NO_4\end{matrix}\right\}O_{20}$ gives carbon 26·23; hydrogen, 2·73; nitrogen, 12·75; oxygen, 58·29. If lignine be treated with nitric acid, combined with more than one equivalent of water, another compound is produced, containing a smaller amount of "nitric acid," most probably $C_{24}\left\{\begin{matrix}H_{17}\\ 3\,NO_4\end{matrix}\right\}O_{20}$, and, as Mr. Gladstone observes, closely resembling pyroxyline,

$$C_{24}H_{20}O_{20} + 3\left(NO_5,\ 2\cdot HO\right) = C_{24}\left\{\begin{matrix}H_{17}\\ 3\,NO_4\end{matrix}\right\}O_{20} + 9\ HO.$$

Again, if pyroxyline be treated with nitric acid containing three equivalents of water, the same compound results:—

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* This occurred at the Laboratory of Trinity College, Dublin.

$$C_{24}\left\{\begin{matrix}H_{18}\\ 2\,NO_4\end{matrix}\right\}O_{20}+2\left(NO_5,\ 3\,HO\right)=C_{24}\left\{\begin{matrix}H_{17}\\ 3\,NO_4\end{matrix}\right\}O_{20}+4\left(NO_5,\ HO\right).^{*}$$

It seems the greatest care is necessary for the purification of the cotton fibres. General Baron Von Leuk has invented a system, known as the "Austrian Method." Mr. Haddon's compound, $C_{36}H_{21}(9\,NO_4)\,O_{30}$, is identical with that of the Austrian trinitrocellulose, $C_{12}H_7(3\,NO_4)\,O_{10}$; it is not of any use in the preparation of collodion, but, as Mr. Gladstone observes, it is Baron Von Leuk's gun-cotton. It has been kept unaltered for fifteen years; it is but slightly hygroscopic, and when exploded in a confined space is free from ash; its explosive temperature is 136° C. (277° F.). Baron Von Leuk treats his gun-cotton with a solution of the silicate of potash (water gas). The amount of silica set free on the cotton by the carbonic acid of the atmosphere is really of service in retarding combustion. Neither nitrous fumes nor prussic acid are among the gases evolved—the one an animal poison, the other a corrosive agent. Karolys found it to contain neither of them, but to consist of nitrogen, carbonic acid, carbonic oxide, water, a small quantity of hydrogen, and light carburetted hydrogen, and these are comparatively harmless; and it is distinctly in evidence that practically the gun is less injured by repeated charges of gun-cotton than of gunpowder, and that the men in casemates suffer less from its fumes. It is almost impossible for it to explode during the process of manufacture, since the cotton is always immersed in liquid unless during the final drying. Again, it may be submerged in water, and only used according as wanted, as it is most easily dried; its destruction in the act of combustion is complete, being wholly resolved into its component gases, and no residuum left in the gun; it produces no recoil, and does not heat the bore in the slightest degree, even under the action of repeated discharges. Scott Russell, Esq., F. R. S., has shown that the waste in gunpowder (average) is sixty-eight per cent. its own weight, only thirty-two per cent. being useful. General Von Leuk has succeeded in timing the velocity of the explosion. In his hands it possesses either one foot per second, or one foot in $\frac{1}{1000}$ of a second. The General uses it in the proportion of one-fourth to one-third weight of powder, occupying $1\frac{1}{10}$ of the length of the powder cartridge. Experiments made by the Austrian Committee show that 100 rounds could be fired of gun-cotton against thirty rounds of gunpowder: 100 rounds of gun-cotton were fired from a 6-pounder in thirty-four minutes, the gun being raised to 122° F., while in the case of gunpowder an equal number of rounds raised the gun to such a temperature that water easily evaporated. The comparative advantages of gun-cotton and gunpowder for producing high velocities may be shown from the following table:—With a Krupp's cast-steel gun (6-pounder), the ordinary charge of 30 ounces of powder produced a velocity of 1·338 feet per second; and with 13½ ounces of gun-cotton a velocity

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[*] See Edin. Phil. Mag., vol. xxxi., p. 519.

of 1·563 feet per second was obtained; with a 12-pounder the results were—

	Calibres.	Charge.	Velocity, feet per second.
Cotton, length,	10	15·9 oz.	1426
Powder,	13½	49 (normal powder charge)	1400
Cotton,	9	17	1402*

Captain Maury, U. S. N., says that iron-clads at Charleston have remained for several hours under fire, the decks not becoming in any way foul, from the entire absence of smoke. I think the foregoing evidence of some of the leading men of science will show that, while it possesses the disadvantage of ignition at a comparatively low temperature, it has the advantages of lightness, freedom from damp, lessening of recoil, not heating or fouling, cheapness of production, and great diminution in weight; and, to sum up all, can be submerged in water, and dried for use according as wanted; for cupola-ships it seems to be especially adapted, as it would to a great extent obviate the fouling in the turrets. Sir W. Armstrong, indeed, is of opinion that where there is no heat in the gases, there can be no projectile force: the initial velocity, however, has been proved to be greater than in the case of powder. Mr. Siemens, having considered the question, is of opinion that the greater heat imparted to the gun by gunpowder is owing to the greater amount of solid matter, which, involving the heat of the gases under a pressure of some 400 atmospheres, imparts a portion of the same by radiation to the side of the gun, while in the case of gun-cotton gases only are produced, which could only impart heat by the slower process of conduction, and leave a larger margin of heat to be developed in force by expansion; while Admiral Sir Edward Belcher supposes it to be owing to the greater rapidity of the explosion, and the absence of fouling matter, which contains and retains the heat. And it is to be hoped that the requisition of the British Association for a Government Commission to inquire into the details of this interesting subject will be granted. In the recent duel between the "Alabama" and "Kearsage," great stress has been laid on the chain armour with which her sides were in a measure protected. William Rowan, Esq., C. E., of Belfast, claims the merit of its invention; he laid, some years ago, a table of results obtained from a target composed of suspended chains, before the government. Now, no doubt, under certain circumstances it may be of benefit—for instance, as Captain Blakely observes, in the case of cast iron shot. Strange to say, it was known well in the reign of Elizabeth: a Captain John Yonge, an officer of, we are told, forty years' experience, suspended chains round

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* Professor Abel, F. R. S., has shown that the formation of trinitrocellulose may be represented by the equation:—

$$\overset{\text{Cotton.}}{C_6H_{10}O_5} + \overset{\text{Nitric Acid.}}{3\left\{\begin{matrix}H\\NO_2\end{matrix}\right\}O} = \overset{\text{Gun Cotton.}}{C_6\left\{\begin{matrix}H_7\\3NO_2\end{matrix}\right\}O_5} + \overset{\text{Water.}}{3\left.\begin{matrix}H\\H\end{matrix}\right\}O}.$$

the sides of his ships, which, he says, rendered them invulnerable to shot and shell.[*] Captain Winslow, U. S. N., of the "Kearsage," indeed, has replied that the chains were not so much for defence as for protecting the boilers and engines of the ship. This I can readily understand, that it was a kind of "impromptu" defence; but that in the case of steel shot or shell driven from the Whitworth hexagonal, or Armstrong 110-pounder, these chains would withstand its concussion, cannot be for a moment believed. The law of continuity of substance forbids such a theory; for, granting the chain netting to be formed of (n) links, then, if one of the series of (n) were destroyed, the law of continuity would perish, and therefore the defensive force. Again, being open, the bursting charges of shells would readily penetrate, even supposing the fragment of the shell to fall outside the ship.

In America it was discovered nineteen years ago that one-fourth inch iron would withstand cast iron shell, and of course, then, chains of say three-fourth inch would act even better; but we know that the "Warrior" target of four one-half inch rolled iron plate is no defence against steel shells; neither did the "Agincourt" target, five one-half inch, withstand the immense impact of the Mackay Gun; and it is highly probable that six or seven inches of iron would offer but slight resistance to these improved pieces of ordnance. What we *really* want, in my opinion, is a resisting substance *outside* the armour plating, for we know that the slightest thickness of an elastic medium increases visibly the resistance. The Rev. Professor Haughton, M. D., F. R. S., has shown in his Table, in connexion with armour-plated frigates, that the value of ϵ^2, the square of the dynamical coefficient of elasticity produced by the collision of bodies, is not constant, but diminishes according to some unknown law, as the velocity of the collision increases, thus :—

Steel falling on iron with a velocity of 16 feet per sec.,
The value of $\epsilon^2 = 0{\cdot}2952$;

but when the velocity increased to 40 feet per sec.,

The value of ϵ^2 *diminished* to $0{\cdot}2245$.[†]

Hence it is apparent that, in rifled guns, the greater the initial velocity, the less the value of rebound. In order to break the force thus augmented, some intervening substance should, I think, be substituted. Cork steeped in some alkali might be beneficial, as the lightness of the cork and its known elastic force, with its imperviousness to flamé, would render it of much advantage in deadening the force of impact. Soft metal all along has been more successful than hard,—rigidity of substance being, it would seem, of rather detrimental tendency. In America cotton bales are used with much advantage, being placed as we place our hammocks round the gunwales,—their elastic force retarding the velocity, and therefore decreasing the force of concussion.

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[*] See "Notes and Queries," August, 1862.

[†] These experiments were made by dropping spherical balls of steel, iron, and brass, 2¼ in. diam., and measuring the height of the rebound : in this instance the weight was merely influenced by gravity.

APPENDIX TO THE FOREGOING PAPER.

EXTRACTS FROM THE REPORT OF THE ORDNANCE COMMITTEE OF THE HONORABLE HOUSE OF COMMONS, 1864.

Examination of Captain the Hon. Arthur Cochrane, R. N., H. M. S. "Warrior."

Quest. (2237).—Which is the most efficient weapon against an iron-plated ship, at short range—the Armstrong 110-pounder, or the old 68 pounder?

Ans.—I have understood, there is no doubt, that the 68-pounder, at short ranges, having a higher initial velocity, would be the more damaging of the two.

Quest. (2240).—Do you suppose that in action these sights (the Armstrong) could be easily brought into action?

Ans.—No; and when at sea with the squadron, last summer, we had to abstain from firing, even when firing slowly, on account of the dense smoke caused by the Armstrong guns, which created more smoke, and of a worse character, than all the rest of the guns.

Colonel W. B. Gardiner, R. A.

Quest. (by the Right Hon. W. Monsell, Chairman).—Were you present at the experiments which were tried, both in November and again very recently, with the Armstrong and Whitworth guns against the iron target?

Ans.—Yes; I was.

Quest.—What was the impression produced upon your mind with regard to the power of penetrating with the Armstrong? Which of the two guns was the more successful on these two occasions?

Ans.—I think, as regards the Warrior target, the Whitworth was by far the more successful. I know the Whitworth got through, and the other did not; that was at a range of 800 yards.

Captain A. T. Blakely, R. A.

Quest.—What is the armament of "La Gloire?"

Ans.—She has 6½ inch rifled guns, of a weight of 5 tons.

Quest.—What is the weight of the shot?

Ans.—The guns throw bolts of 99 lbs.

Quest.—Do you think the Armstrong 110-pounder, at 400 yards, would have the same effect on "La Gloire" as a French gun?

Ans.—I think not.

Quest.—Then you think the French guns are superior to the Armstrong gun?

Ans.—I am sure of it.

The weight of the Armstrong 110-pounder is 83 cwt.
,, the old 68-pounder, 95 cwt.
Whitworth 12-pounder (breech-loader), $3\frac{1}{2}$ diameters:—
Weight of shot, $14\frac{58}{100}$ lbs.
Initial velocity, 121 feet per sec.

By multiplying the weight of the shot by the square of the velocity, the result is 22,813,000 lbs. work done.

Comparison between the "Royal George" and "Glatton."

H. M. S. "Royal George," 78 Guns.	H.M.S. "Glatton" (iron-cased), Battery, 14 Guns.
Tonnage, 2616.	Tonnage, 1535.
Speed, 9·375 knots.	Speed, 4·5 knots.
Length between perpendiculars, 205 ft. 7 in.	Length between perpendiculars, 172 ft. 6 in.
Breadth, extreme, 54 ft. $6\frac{1}{2}$ in.	Breadth, extreme, 45 ft. $2\frac{1}{2}$ in.
Draught forward, 22 ft. 10 in.	Draught forward, 8 ft. 4 in.
,, aft, 23 ft. 10 in.	,, aft, 8 ft. 8 in.
Displacement, 4110.	Displacement, 1640.
Rate in knots per hour, 10·397.	Rate in knots, 14·539.
Length to breadth, 3·77.	
Nominal horse power, 400.	Nominal horse power, 150.
Speed, ^{3} × mid. sec. indicated power, 543·5.	Ditto, 49·8.
Speed, ^{3} × displacement $\frac{2}{3}$, indic. power. 1·332.	Ditto, 18·3.

The greatest sea speed yet obtained is that of the Kingstown and Holyhead R. M. S. "Connaught," 2056 tons, B. M.; length, $348\frac{5}{8}$ feet; 17·797 knots (mean) = 20·502 statute miles; nominal horse power, 720; indicated horse power, 4200.

Result of official Trial of H. M. Armour-cased Steam Sloop, "Enterprise" (designed by Mr. Reed, Constructor of the Royal Navy).

Tonnage.	Horse Power.	Guns.	Draught forward.	Draught aft.
990	160	4	11 ft. 10 in.	15 ft. 8 in.

FULL BOILER POWER.
Speed at measured Mile.

	Time.		Revol. Engines.	Speed. Knots.	Pressure Steam.	Vacuum.	Revol. Screw.
	m.	s.			lbs.		
First run, ...	7	40	98	7·826	$23\frac{1}{2}$	26	56
Second run, . . .	5	13	—	19·027	$22\frac{1}{2}$	26	99
Third run, ...	6	32	98	7·265	22	$26\frac{1}{2}$	,,
Fourth run, ...	5	3	100	11·881	23	27	,,
Fifth run, ...	7	26	97	8·072	22	$26\frac{1}{2}$	,,
Sixth run, ...	5	8	100	11·681	$22\frac{1}{2}$	$26\frac{3}{4}$	,,

Taking the first of the above runs, we get—

First means, . . .	9·913	9·982	9·923	9·976	9·880	
Second means,. . .	9·880	9·952	9·949	9·928	—	

giving the true mean speed of the ship 9·227 knots, or about 10 statute mile per hour.

HALF BOILER POWER.

Speed at measured Mile.

	Time.		Speed.	Revol. Engine.	Press. Steam.	Vacuum.
	m.	s.			lbs.	
First run, ...	6	27	8·022	80	19	26
Second run,.	8	54	9·363	81	19	26½
Third run, ...	8	56	6·716	81	19	26
Fourth run, ...	6	19	9·499	82	19	26½

Average speed at half boiler power, 8·105 knots.
In all these runs the force of wind was 5.

STEERING QUALITIES.

Angle of Rudder.	Time of Full Circle.			
Degrees.	m.	s.		
30	4	14	Port,	full speed.
29	4	18	Starboard,	
27	4	3	Port,	half speed.
28	4	37	Starboard,	

The Rev. Samuel Haughton, M. D., Fellow of Trinity College, Dublin, read the following paper:—

NOTES ON ANIMAL MECHANICS.

No. IV.—ON THE MUSCULAR ANATOMY OF THE LION.

During the month of January last a fine Lion died of fever in the Zoological Gardens of this city, which had lived there for upwards of twelve years. I purchased his body for the use of the Anatomical School of Trinity College, in which the dissections were made which are used in this paper. I am indebted to Mr. Little, Medical Scholar of Trinity College, for the drawings from which two of the woodcuts were copied. The animal was in fine condition; both fat and muscle being well developed, which was to be expected, as he died after a short illness, which commenced on the 27th of December, 1863, and terminated fatally on the morning of the 12th of January, 1864. The Lion died of fever, and his chance of recovery was destroyed by the occurrence of three days' frost during his illness. We had no means of protecting him from the cold, and from the still more deadly damp that followed it during the thaw; and notwithstanding that he rallied for one day, under the influence of stimulants, he ultimately succumbed to the disease, and died with all the symptoms of a human being in fever. The only pathological appearances found after death were—a small circumscribed patch of consolidation in the right lung, and traces of chronic rheumatic arthritis in the right shoulder joint.

PART I.—MUSCLES OF THE HIP AND KNEE JOINTS.

1. *M. biceps femoris* weighs . . . . 27$\frac{3}{4}$ oz.

This muscle is shown in Fig. 13, and forms a massive triangular sheet, having for its origin the highest point of the *tuber ischii*; and is inserted by strong fascia continuously from the middle of the femur covering the *vastus externus*, down the entire length of the outer side of the leg, as far as the *tendo Achillis*, round which it is fastened. The total length of the muscular fibres from *tuber ischii* to *tenao Achillis* is 22$\frac{1}{4}$ inches, and from *tuber ischii* to highest insertion on femur 8$\frac{3}{4}$ inches; and when the leg is extended, the third side of the muscular triangle is 17$\frac{1}{4}$ inches. If the whole sheet of muscle be supposed of uniform thickness (which was nearly the case), the simultaneous contraction of all its fibres will draw the base of the muscular triangle towards its origin, parallel to itself; and the resultant of all the forces will lie in the bisector of the vertical angle. This resultant must therefore divide the base in the proportion of 22$\frac{1}{4}$ to 8$\frac{3}{4}$ inches. On making the calculation, it is found that the resultant intersects the base at a point 12·38 inches above the *tendo Achillis*. This point corresponds with the knee joint, and the effect of the whole muscle is the same as that of a single linear muscle from the *tuber ischii* to the top of the fibula.

2. *M. bicipiti accessorius.** This muscle is represented by a long slender slip, intimately associated with the *biceps*, two feet in length, passing from the *os calcis* to the posterior point of the sacrum. It is shown at K, Fig. 14.

3. *M. agitator caudæ* weighs $6\frac{1}{2}$ oz.

Origin from 1st, 2nd, and part of 3rd caudal vertebræ.

Insertion, by a long tendon into the outer side of the patella. This muscle is shown at C, Fig. 14. Its use is to wag the tail in a feline, not canine fashion; and also to secure the proper action of the patella preparatory to a spring. This seems to be the final cause of the violent agitation of the tail, vibrated from its first and second vertebræ, that forms so remarkable a characteristic of all the Felines. Considered from this mechanical point of view, the function of the *agitator caudæ* in the Lion is similar to that of the *rectus femoris* in the Ostrich.

4. *M. semitendinosus* (G, Fig. 14), weighs . . . . 10 oz.

Origin from *tuber ischii.*

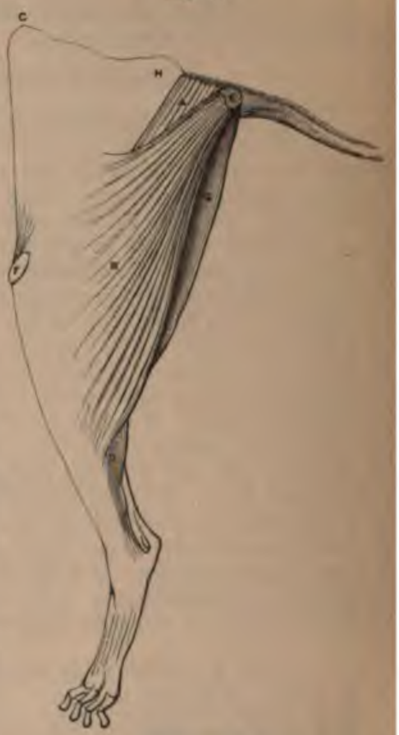
Insertion, at upper point of trisection of the *tibia.*

5. *M. semimembranosus* (H, Fig. 14), weighs . . $26\frac{1}{4}$ oz.

Origin, from *tuber ischii.*

Insertion, into head of *tibia*, with a broad fascial insertion above and below the knee joint.†

Fig. 13.



LEFT LEG OF LION.

(with skin removed, showing superficial layer of muscles).

A, *M. agitator caudæ.*
B, *M. biceps femoris.*
C, Crest of the *ilium.*
D, Tendinous insertion of posterior fibres of *biceps*, round *tendo Achillis.*
E, *Tuber ischii.*
F, *Patella.*
G, *M. semitendinosus.*
H, Great *trochanter.*

---

* It was suggested to me by Mr. Little that this muscle was the representative of the *plantaris*; and as I had found it to occur in the Dog and Badger, I was disposed to regard it as the representative of this muscle in the Carnivores. I am compelled to abandon this view from the observation of the fact, that in the Otter, in which animal also it is found, there is a well-marked *plantaris* occupying its usual position in the calf of the leg.

† For details, *vide* Fig. 15.

The *biceps* and *semimembranosus* act in planes parallel to the plane of motion of the knee joint, and from their mode of action must both have resultants passing through the junction of the thigh and leg, so that they must be regarded as principally extensors of the thigh, and not as flexors of the leg. The *semitendinosus*, on the other hand, acts as a flexor of the leg, and seems to abduct by the same angle that *gracilis* adducts; so that, considering that their weights are nearly equal, the resultant of *gracilis* and *semitendinosus* will also lie in the plane of motion of the knee joint.

6. *M. gracilis* weighs 9 oz.

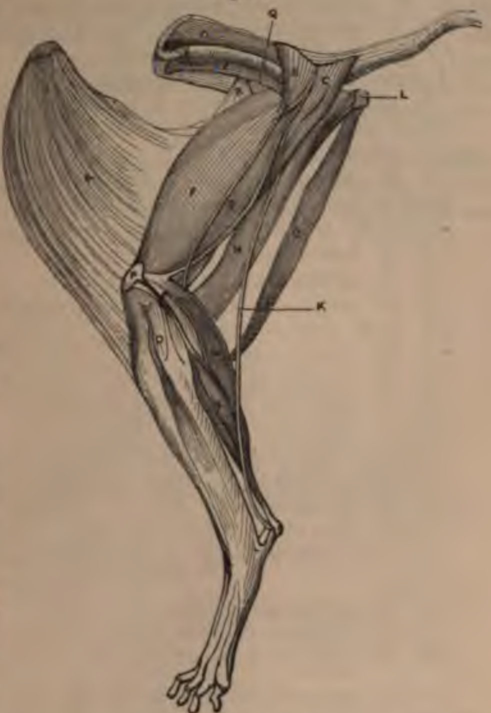
7. *M.** *adductor magnus* weighs 27¼ oz.

Origin, inner border of *symphysis pubis*, and round the edge of the *M. obturator externus*, as far as the *tuber ischii*.

Insertion, along the *linea aspera*, through entire length of the back of the *femur*.

8. *M. adductor longus* weighs . . 2¾ oz.

Fig. 14.



LEFT LEG OF LION.

(with *biceps femoris* reflected, to show the deeper muscles).

A, *M. biceps femoris*, reflected.
B, *M. glutæus maximus.*
C, *M. agitator caudæ.*
D, *M. glutæus medius*, its lower border reflected, to show,
E, *M. glutæus minimus.*
F, S, *M. vastus externus.*
G, *M. semitendinosus.*
H, *M. semimembranosus.*
K, *M. bicipiti accessorius.*
L, *Tuber ischii.*
M, *M. gastrocnemius.*
N, Portion of *gastrocnemius*, sending a separate tendon to the patella.
O, Lateral ligament of knee.
P, *Patella.*
Q, *M. iliocapsularis.*
R, *M. rectus femoris.*

---

* The action of the *adductor magnus* is one of the most complicated in animal mechanics—for its origin is a curve, and its insertion a line, and these lie in different planes. Probably, in the Lion, half its muscular force is expended in simple extension of the femur, and the remaining portion, as in man, opposes the *glutæus medius.*

9. *M. pectinæus* passes over lesser trochanter, and weighs . ¾ oz.
10. *M. glutæus maximus* (B, Fig. 14) weighs . . . . . . 3½ oz.
Origin, from last *sacral* vertebræ.
Insertion, into glutæal trochanteric ridge, for 2½ inches.
11. *M. glutæus medius* (D, Fig. 14) weighs . . . . . . 14½ oz.
These *glutæi* divide the interval from the first caudal vertebra to the crest of the ilium, equally.
12. *M. glutæus minimus* (E, Fig. 14) weighs . . . . . . 2½ oz.
Origin, from the dorsum of the ilium.
Insertion, at inner side of great trochanter.
13. *M. tensor vaginæ femoris** weighs . . . . 6½ oz.
14. *M. sartorius* weighs . . . . 11¾ oz.
15. *M. rectus femoris* (R, Fig. 14), weighs . . . . . . 11 oz.
16. *MM. vasti et cruræus*, ... 32 oz.
17. *M. psoas parvus*, ... 2½ oz.
18. *M. Psoadiliacus*, ... 10¾ oz.
19. *M. quadratus femoris*, ... 1·58 oz.
Origin, from *tuber ischii*.
Insertion, into posterior intertrochanter ridge.
This muscle acts in the plane of the knee joint.
20. *M. iliocapsularis* (Q, Fig. 14), weighs . . . . 0·53 oz.
Origin, from *ilium*, behind the origin of *rectus femoris*.
Insertion, into the front of the *femur*, on the line below the great trochanter.
21. *M. pyriformis* weighs . . . . 2½ oz.
22. *M. obturator externus* weighs . . . . 2·60 oz.
23. *M. obturator internus* weighs . . . . 4 oz.

It has been well observed by Cuvier, that man is remarkably distinguished from the Quadrumans, by the preponderance of the *glutæus maximus* over the other *glutæi*. This is essentially a bipedal characteristic, as is shown in the following comparative Tables:—

Comparison of Glutæal Muscles in Man.

	Man.
1. Glutæus maximus,	53
2. Glutæus medius,	34
3. Glutæus minimus,	13
	100 parts.

Comparison of Glutæal Muscles in the Macaque, the Lion, and the Ostrich.

	Macaque.	Lion.	Ostrich
1. Glutæus maximus, Agitator caudæ, and Tensor vaginæ, combined,	28	49	76
2. Glutæus medius,	61	43	21
3. Glutæus minimus,	11	8	3
	100	100	100

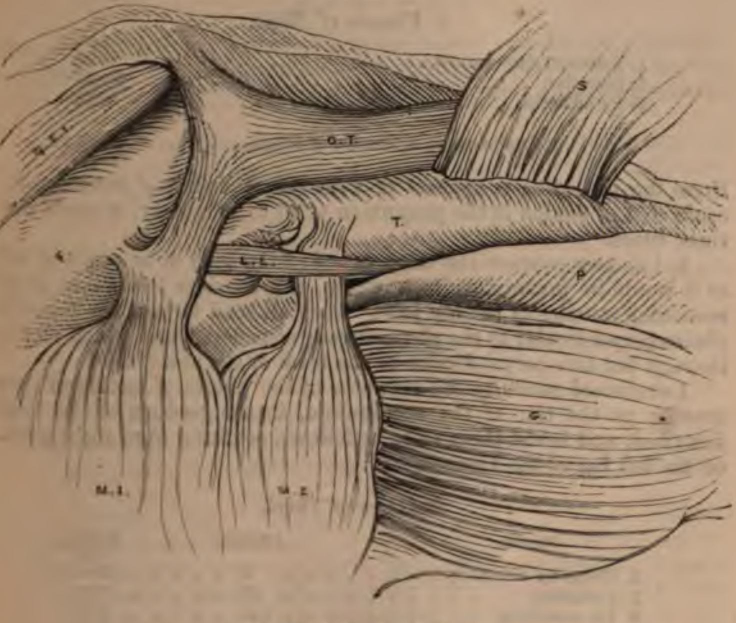
---

* The *tensor vaginæ* and *sartorius*, when acting in conjunction to flex the thigh, give a resultant in the plane of the knee joint.

Judged by the preceding comparative Tables, Man possesses the characteristic referred to, in a lesser degree than the Ostrich, in a greater degree than the Lion, and in a very much greater degree than the *Macacus Nemestrinus*. Strictly speaking, the Macaque is neither a biped like the Ostrich or Man, nor a quadruped like the Lion, but is a climber, and has relations of forces among the muscles of the posterior limb suited to that mode of locomotion.

The following figure, which shows the arrangement of the tendons at the inner side of the knee joint, was drawn from nature by my son, and will serve to explain any obscurity in the preceding descriptions of the muscles and their attachments:—

Fig. 15.



INNER SIDE OF LEFT KNEE OF LION.

F, *Femur.*
T, *Tibia.*
S, *M. sartorius*, reflected.
P, *M. popliteus.*
G, *M. gastrocnemius.*

Q, E, I, *M. quadriceps extensor internus.*
M 1, and M 2, Insertions of *M. semimembranosus* into the *tibia*, *femur*, and *patella.*
C, T, *Aponeurosis.*
L, L, Lateral ligament of knee joint.

PART II.—ACTION OF THE MUSCLES OF THE HIP AND KNEE JOINTS.

The most important of the muscles just enumerated exert their action in extending or flexing the thigh upon the body in the plane of motion of the knee joint, which is parallel to the brim of the acetabulum in ordinary positions of the leg.

They may be classed as follows:—

1. *Extensors of Thigh.*

	Ozs.
1. Biceps femoris,	27·75
2. Semitendinosus,	10·00
3. Semimembranosus,	26·25
4. Gracilis,	9·00
5. Adductor magnus,*	13·62 ?
6. Adductor longus,	2·75
7. Quadratus femoris,	1·58
Total moment of Extension of Thigh,	90·95 oz.

2. *Flexors of Thigh.*

	Ozs.
1. Tensor vaginæ femoris,	6·50
2. Sartorius,	11·75
3. Psoadiliacus,	10·75
Total moment of Flexion of Thigh,	29·00 oz.

From the preceding it appears that the total moment of extension exceeds that of flexion in the proportion of 91 to 29, nearly, or more than three times.

Let us now suppose the thigh flexed on the body at an angle of 45°, as it would be preparatory to a spring, and consider the action of the remaining muscles of the hip joint. They all tend to turn the femur in planes perpendicular to the plane already considered, and which all pass through the axis perpendicular to the brim of the acetabulum.

I examined carefully the azimuths of the planes of motion of these muscles on the rim of the acetabulum, in the position of the thigh described, and found them to be as follows, counting from right to left, on the left leg of the Lion:—

Rotators of Thigh.

Muscles.	Azimuth.	Moment. Ozs.
1. Obturator externus,	0°	2·60
2. Pectinæus,	60	0·75
3. Ilio capsularis,	149	0·53
4. Glutæus minimus,	167	2·50
5. Glutæus medius,	193	14·50
6. Pyriformis,	266	2·50
7. Glutæus maximus,	266	3·50
8. Obturator internus,	277	4·00
9. Agitator caudæ,	277	6·50
10. Adductor magnus,	360	13·62 ?
Total moment of Muscles rotating the Thigh,		51·00 oz.

---

* Half the force of the *adductor magnus* is here supposed to act in the plane of motion of the knee joint.

It is probable that the muscles here given as rotators never act together in one leg only, for the Lion never attempts to stand on one leg; but it may be useful to calculate what would be the direction and magnitude of their total resultant. Assuming the plane of the component couple X to be that of the muscles *obturator externus* and *adductor magnus*, we find—

$$X = 16{\cdot}22 + 0{\cdot}75 \cos 60^\circ - 0{\cdot}53 \cos 31^\circ - 17 \cos 13^\circ - 6 \cos 86^\circ + 10{\cdot}5 \cos 83^\circ = 0{\cdot}29 \text{ oz.}$$

$$Y = 0 + 0{\cdot}75 \sin 60^\circ + 0{\cdot}53 \sin 31^\circ - 12 \sin 13^\circ - 6 \sin 86^\circ - 10{\cdot}5 \sin 83^\circ = -18{\cdot}18 \text{ oz.}$$

$$\frac{Y}{X} = -\tan(89^\circ\ 5')$$

$$\sqrt{Y^2 + X^2} = 18{\cdot}18 \text{ oz.}$$

The resultant moment of all the muscles causing rotation lies, therefore, in a plane nearly perpendicular to the plane of the *obturator externus*, and is represented by a weight of lion flesh of 18·18 oz. acting towards the body.

When the Lion crouches on his haunches, with his feet somewhat apart, and knees approximated, acting as fulcra, the origins and insertions of the rotator muscles are converted, and they all become available to assist in his spring, which is thus aided by the propulsion of the haunch upwards by the joint action of the rotator muscles of both legs; and his body is at the same time propelled forward by the action of all the extensors of the thigh, leg, and foot of both sides.

PART III.—MUSCLES OF SHOULDER AND ELBOW JOINTS.

1. *M. pectoralis major*, ... 34¼ oz.
   Origin, from whole length of sternum.
   Insertion, into whole length of pectoral ridge of humerus, with a slip joining the *deltoido-trapezius* as it passes on to be inserted in the radius.
2. *M. pectoralis minor*, ... 7¾ oz.
3. *M. deltoido-trapezius*, ... 15¾ oz.
   This conjoined muscle forms a large sheet, covering the scapula and head of humerus, and flowing freely over them in the rapid actions of the arm; it is inserted partly into the moveable clavicle, and partly into the inner side of the ulna, one inch below the elbow joint.
4. *M. deltoideus proprius*, ... 4¾ oz.
   Origin, anterior third of spine of scapula.
   Insertion, deltoid ridge on outer side of humerus.
5. *M. cleido-mastoideus*, ... 4¼ oz.
   This muscle has a double origin, from the mastoid process and from the transverse process of the dentatus; it is inserted into the floating clavicle.

6. *M. levator anguli scapulæ*, ... 2¼ oz.

Origin, from the fascia in the upper part of side of neck.

Insertion, into the anterior extremity of the vertebral edge of the scapula.

7. *M. serratus magnus*, ... 20¾ oz.

8. *M. rhomboideus major*, ... 7¾ oz.

This muscle is inserted into the vertebral edge of the scapula, and rotates it in a direction opposite to that of the *serratus magnus*.

9. *M. rhomboideus minor*, ... ½ oz.

This muscle, though rudimentary, is distinct.

10. *M. supraspinatus*, ... 14⅓ oz.

11. *M. infraspinatus*, ... 13 oz.

12. *M. subscapularis*, ... 14⅔ oz.

13. *M. triceps*, ... 43⅓ oz.

14. *M. teres major*, ... 9⅓ oz.

Origin, whole posterior edge of the scapula.

Insertion, into the middle third of the humerus, by means of a flat tendon.

15. *M. latissimus dorsi*, ... 25½ oz.

This vast sheet of muscle is inserted into the middle of the tendon of the *teres major*, at four inches distant from the humerus.

16. *M. biceps*, ... 8 oz.

17. *M. brachialis externus*, ... 4 oz.

18. *M. coraco-brachialis*, ... ¼ oz.

This muscle is rudimentary, but regular, and possesses a long tendon, also rudimentary.

PART IV.—MUSCLES OF MASTICATION.

1. *M. masseter.*

This muscle is divided into two distinct portions; one external, with fan-shaped fibres radiating from the angle of the jaw, and more or less horizontal; and the other internal, with vertical fibres, arising from the whole internal surface of the zygoma, and inserted into the masseteric cavity of the ramus.

The external, or horizontal portion, weighs . . . . . . 11 oz.

The internal, or vertical portion 6½

The second portion of the *masseter* is a direct closer of the mouth.

2. *M. temporalis.*

The temporal muscle is also divided into two; one superficial, arising partly from the superficial fascia, and partly from the margin of the temporal fossa, behind the ear, and from the back of the orbit; this portion, in passing downwards to the coronoid process, becomes blended with the internal portion of the *masseter* on the outer side, and with the second portion of the temporal on the inner side.*

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* This superficial portion of the temporal muscle is well seen in the Otter, in which animal it is better separated from the masseter, and from the true temporal, than in the Lion.

The second part of the temporal muscle has the usual origin and insertion.

The superficial temporal weighs . . . . 6 oz.
The true temporal, ... 16½ oz.

The vertical fibres of the *masseter* close the jaw directly without producing any pressure on the joint; but the fan-shaped fibres of this muscle cause a powerful pressure on the condyle of the lower jaw, forcing it backwards into its socket. Such seems to be also the function of the superficial fibres of the temporal muscle, which press the condyle into its socket, as well as close the mouth. This pressure seems to be necessary, in consequence of the habit the Lion has of carrying his prey in his mouth for a long time before he devours it; for the weight so carried would inevitably dislocate the jaw, if there were not a special provision made in the action of the masticating muscles to guard against it.

3. *MM. pterygoidei.*

The first part of these (*externus*) weighs . . . . ¾ oz.

Its origin is the posterior portion of the pterygoid plate, and it is inserted into the *masseter* muscle at the angle of the jaw. Its action is to draw the fibres of the masseter forward, and give them a longer leverage.

The second portion of the pterygoid muscle (internus) weighs 2 oz.

It arises from the anterior portion of the pterygoid plate, with an extensive origin also from the floor of the orbit, and is inserted two inches from the angle of the jaw.

Its action is to close the jaw, and draw it forward.

4. *M. digastricus*, ... 2½ oz.

This is the proper muscle for opening the mouth in all the carnivora.

Its origin is the mastoid process.

Its insertion is into a line 3½ inches in length backwards from the symphysis of the jaw, along the mylo-hyoid ridge.

The Rev. Samuel Haughton, M. D., Fellow of Trinity College, Dublin, read the following Paper:—

NOTES ON ANIMAL MECHANICS.

No. V.—THE MUSCULAR ANATOMY OF THE SEAL.*

The muscular anatomy of the Seal differs in many important particulars from that of the other Carnivores; and this difference seems to be occasioned principally by its aquatic habits, which render it better adapted for locomotion in the water than on dry land. In the anterior limbs, everything is sacrificed to the swimming action of the arms, which seem to be placed in the centre of elliptical masses of muscles converging to a common centre, the fibres of which, by their successive contraction, produce the monotonous circular motion requisite for swimming; while the feathering action of the hand is provided for by powerful supinators. In the posterior extremity the swimming action is more like that of the tail of the fish, and consequently the feet are blended with the tail, and their swimming action is effected chiefly by lowering the insertions of all the muscles, thus sacrificing the delicate motions of the thigh to the coarser action of the whole leg, considered rather as a portion of the tail than as a distinct member of the body.

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* The drawings from which the woodcuts were made were taken from nature by my son.

Notwithstanding this subordination of the function of the muscles in both extremities to the purposes of a single and simple action, it is wonderful to observe how perfectly each muscle retains its individuality; so much so, indeed, that there are few animals whose muscles in both limbs are more perfectly developed than are those of the Seal.

PART I.—MUSCLES OF THE ANTERIOR LIMBS.

1. *M. pectoralis major*, ... 10 oz.
   This muscle arises from the whole length of the sternum (14 inches), and is inserted into the well-marked pectoral ridge of the humerus; its fibres are succeeded at the xiphoid cartilage by the converging fibres of the next muscle, which forms the lower half of the superficial muscular ellipse, having its centre at the head of the humerus.
2. *M. latissimus dorsi superficialis*, ... 18 oz.
   Origin; usual origin from posterior aspects of posterior ribs and back, in front blending with the *panniculus carnosus*, it takes an origin from the anterior line of the pelvis and mesian line of the abdomen, completing its semielliptical origin at the xiphoid cartilage, where it is succeeded by the great pectoral.
   Insertion; by means of a tendon common to it and *great pectoral* into pectoral ridge.
3. *M. Trapezius*, ... $4\frac{1}{2}$ oz.
   Origin; from all the cervical and dorsal vertebræ.
   Insertion; into the outer side of head of humerus, and into the spine of the scapula.
   This muscle continues through another quadrant the elliptical circuit of muscles commenced by Nos. 1 and 2.
4. *M. humero-occipitalis*, ... 4 oz.
   Origin; from posterior line of the aponeurotic origin of the temporal muscle.
   Insertion; pectoral ridge of humerus, inner side.
   This muscle is continuous with the *trapezius* behind, and with the *pectoralis major* in front, and completes the elliptical circuit of superficial muscles, which may be regarded as an essential characteristic of aquatic quadrupeds. It corresponds to the su-

perior part of the human trapezius, which is inserted in the clavicle.

5. *M. Sternomastoideus.*

The sternal portion of the mastoid muscle is represented in the Seal by two distinct muscles—

(*a*)—The first having its origin inside the top of the sternum, and its insertion, by a fine tendon, into the mastoid portion of the temporal bone, ... 1 oz.

(*b*)—The second having its origin from the whole length of the first rib; and its insertion into the under part of the lower jaw, near the symphysis.

6. *M. Omo-atlanticus*, ... $1\frac{1}{4}$ oz.

Origin; from transverse process of the atlas.

Insertion; into the top of the pectoral ridge of the humerus, on the outer side.

This is the muscle which I have described in Note 2, as occurring in *Cercopithecus* and *Macacus*, under the name of *trachelo-acromius*, of Cuvier. In the Seal, its insertion is shifted from the spine of the scapula to the humerus, where it assists the general swimming or rotatory action of the limb.

7. *M. levator anguli anterioris scapulæ*, ... $\frac{3}{4}$ oz.

Origin; from the transverse process of the atlas.

Insertion; into the vertebral edge of the scapula, at the end of the scapular ridge.

This is the *levator anguli scapulæ* of anthropotomists, with origin and insertion somewhat shifted; it is really a portion of the *M. serratus magnus*.

8. *M. serratus magnus*, ... *not recorded.*

Origin; from the transverse processes of the cervical vertebræ from the 2nd to the 7th.

Insertion; into the vertebral edge of the scapula, behind its spine.

9. *M. levator anguli posterioris scapulæ*, ... $1\frac{1}{2}$ oz.

Origin; central portion of occipital ridge.

Insertion; posterior exterior angle of vertebral edge of scapula; marked *d*, Fig. 17.

The mechanical action of both levators is similar.

10. *M. latissimus dorsi proprius*, ... $3\frac{3}{4}$ oz.

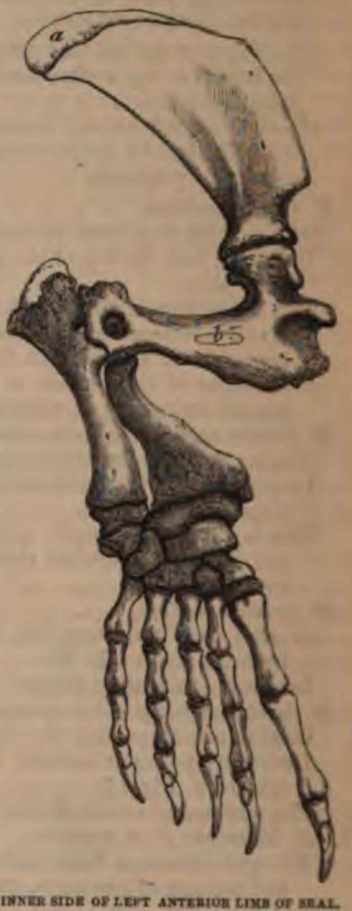
The true *latissimus dorsi* underlies the superficial, already noticed, and consists of two parts, quite distinct, viz.—

(1) Humero-dorsalis, ... $\frac{3}{4}$ oz.
(2) Scapulo-costalis, ... 3 oz.

The first of these muscles (1), or *humero-dorsalis*, represents the *latissimus dorsi* of anthropotomists; its origin is from the spinous processes of the posterior dorsal vertebræ and from their ribs; and its insertion is by means of a tendon common to it and the *M. teres inferior* into the inner side of the upper part of the humerus, at the line marked (*b*) in Fig. 16.

Its action is to rotate the arm inwards, and extend it upon the body; and it also serves mechanically, to keep the posterior angle of the scapula close to the ribs, for in passing to its insertion in the humerus, it overlaps the scapula over the space marked (*a*) in Fig. 17, which also represents the origin of the *teres inferior* muscle.

Fig. 16.



INNER SIDE OF LEFT ANTERIOR LIMB OF SEAL.

a, Insertion of *M. latissimus dorsi scapulo-costalis.*
b, " *M. latissimus dorsi humero-dorsalis*, and *M. teres inferior.*

The second part of the true *latissimus dorsi* muscle, (2) called *scapulo-costalis*, has an abdominal origin (with indigitations), corresponding to the dorsal origin of the *humero-dorsalis*, beneath which it passes to be inserted on the inner face of the cartilaginous prolongation of the vertebral edge of the scapula marked *a* in Fig. 16. These two muscles form a portion of an inner elliptical plane of converging fibres, corresponding to the outer plane of the superficial *latissimus dorsi*, whose function as a swimming muscle has been already noticed.

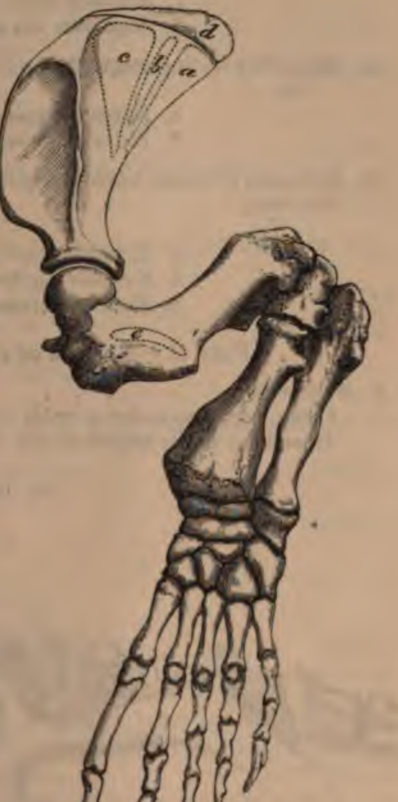
11. *M. teres inferior*, . . ½ oz.
    Origin; marked *a* in Fig. 17.
    Insertion; by tendon common to it and *latissimus dorsi humero-dorsalis* into line marked *b*, in Fig. 16.
12. *M. teres superior*, . 1·47 oz.
    Origin; triangular space on outer side of scapula, marked *c*, Fig. 17, and from spine of scapula.
    Insertion; outer side of pectoral ridge, along line marked *e*, Fig. 17.
13. *M. supraspinatus*, . 1·85 oz.
14. *Infraspinatus*, . . 0·47 oz.
    Inserted just above the *teres superior*, on the humerus.
15. *M. subscapularis*, . . 5·5 oz.
16. *M. triceps*, ... 5·0 oz.

This muscle has two scapular and one humeral head; one of the scapular heads is marked *b*, Fig. 17, the other is near the glenoid cavity, and the humeral head is as usual in all mammals.

17. *M. tricipiti accessorius*, ... 0·57 oz.

This muscle is superficial, and has its origin in the fascia underlying the skin of the back of the arm—it aids the *triceps*, and also braces up the skin of the back of the arm.

Fig. 17.



OUTER SIDE OF LEFT ANTERIOR LIMB OF THE SEAL.

a, Origin of *teres inferior*.
b, One of the scapular origins of *triceps*.
c, Origin of *teres superior*.
d, Insertion of *levator anguli posterioris scapulæ*.
e, " *teres inferior*.

18. *M. anconæus*, . . . 0·23 oz.

Origin; back of inner condyle.

Insertion; inner side of olecranon process.

19. *M. biceps humeri*, . 1·20 oz.

20. *M. brachialis externus* = *Supinator radii longus*, 0·20 oz.

Origin; line on humerus in continuation of that of the insertion of *teres superior*.

Insertion; anterior superior *crest of radius* (*styloid process*), by means of strong twisted tendinous fascia.

21. *M. brachialis anticus*, 0·35 grs.

Origin; whole outer surface of humerus, below the insertion of *teres superior* (Fig. 17, *e*), and origin of *brachialis externus*.

Insertion; upper and back side of ulna, on a line level with the insertion of the biceps into the tubercle of the radius.

22. *Pronators*, ... 1·55 oz.

viz., 1. *Pronator radii teres*,
2. *Flexor carpi radialis*,
3. *Flexor communis, digitorum*.

These have their origin from the inner condyle of the humerus.

23. *Flexors* of wrist, having their origin from the olecranon process, ... 1.63 oz.
viz.

1. *Flexor carpi ulnaris,*
2. *Flexor digitorum communis,*
3. *Natatorius cuticularis.*

24. *Supinators* having origin from external condyle of humerus, 0·85 oz.
viz.

1. *Extensor carpi radialis,*
2. *Supinator lævis.*

25. *Supinators* having origin from olecranon process . . . 0·55 oz.
viz.

1. *Extensor ossis metacarpi pollicis.*
2. *Extensor primi pollicis internodii.*

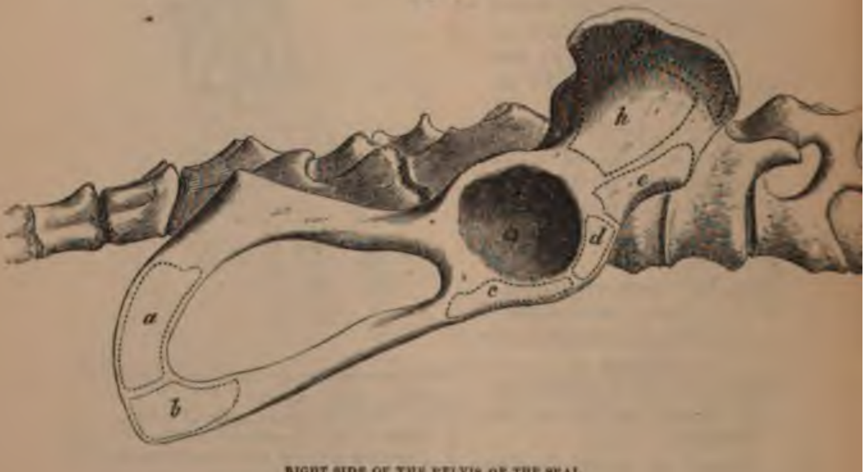
26. *Extensors* of wrist, having origin from the external condyle of the humerus, ... 0·40 oz.
Viz.,

1. *Extensor carpi ulnaris.*
2. *Extensor digitorum communis.*
3. *Extensor minimi digiti.*

Part II.—Muscles of the Posterior Limbs.

1. *M. gracilis,* . . . . 1·88 oz.
Origin; from symphysis pubis (*vide* Fig. 18, *b*).
Insertion; whole length of side of tibia.

Fig. 18.



RIGHT SIDE OF THE PELVIS OF THE SEAL.

a,	Origin of the	*adductor solus.*	*e*,	Origin of the	*rectus femoris.*
b,	,,	*gracilis.*	*f*,	,,	*sartorius.*
c,	,,	*pectinæus.*	*g*,	,,	*glutæus medius.*
d,	,,	*iliacus.*	*h*,	,,	*glutæus minimus.*

2. *M. adductor solus*, ... 0·45 oz.

Origin; from $\frac{3}{4}$ in. behind symphysis pubis, for one inch along the ramus of the ischium (*vide* Fig. 18, *a*).

Insertion; if the tibia be divided into sixths, the insertion of this, the only adductor, is into the 2nd, 3rd, and 4th sixths reckoned from the top.

3. *M. pectinæus*, ... 0·09 oz.

The origin is shown in Fig. 18, *c*.

4. *M. iliacus*, ... 0·36 oz.

Origin; marked in Fig. 18, *d*.

Insertion; the inner condyle of the femur.

5. *M. quadriceps extensor femoris*, ... 1·15 oz.

Origin; the origin of the *rectus* is shown in Fig. 18, *e*.

6. *M. sartorius*, ... 0·15 oz.

Origin; shown in Fig. 18, *f*.

Insertion; inner side of the patella, and overlying the *rectus femoris*.

7. *M. tensor vaginæ femoris*, ... *not recorded.*

Origin; from the fascia covering the crest of the ilium, and overlying the *glutæus medius*.

Insertion; outer side of the patella.

8. *M. glutæus maximus*, ... 2·34 oz.

Insertion, into the great trochanter, whole outer side of femur, and top of fibula.

9. *M. glutæus medius*, including *pyriformis*, ... 0·48 oz.

Origin; marked at *g*, Fig. 18.

10. *M. glutæus minimus*, ... 0·45 oz.

Origin; marked at *h*, Fig. 18.

11. *M. agitator caudæ*, ... 0·98 oz.

Origin; first five caudal vertebræ.

Insertion; upper half of the tibia.

12. *M. obturator externus*, ... 1·02 oz.

13. *M. biceps femoris*, ... 0·45 oz.

Origin; *tuber ischii*.

Insertion; into the fascia covering the whole outer side of the leg, as in the Lion and other Carnivores; it is a triangular muscle.

14. *MM. semimembranosus et tendinosus*, ... 0·35 oz.

These muscles conjoined are represented by a single muscle, having its origin from the first caudal vertebra, and its insertion into the lower third of the *fibula*.*

Before describing the muscles of the leg, it is worth while to sum up the evidence for the assertion made at the commencement of this Paper, that the muscles of the posterior limb in the Seal differ from those of other Carnivores, principally in the shifting of their insertions to lower points on the leg.

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* It is to be observed that this muscle is inserted into the *fibula*, and not into the *tibia*.

Comparison of Insertion of Muscles in the Seal and Lion.

Muscle.	Point of Insertion.	
	Seal.	Lion.
1. *Adductor magnus*, .	Upper 2nd, 3rd, and 4th sixths of tibia, . . .	Whole length of femur.
2. *Iliacus*, ...	Inner condyle of femur, .	Lesser trochanter,
3. *Glutæus maximus*, .	Outer side of femur and top of fibula, ...	Along glutæal in chanteric ridge.
4. *Agitator caudæ*, . . .	Upper half of tibia, . . .	Outer side of patel
5. *Semimembranosus et tendinosus*, . . .	Lower third of fibula, . .	Inner side of kne upper third of ti

15. *M. gastrocnemius*, ... 2
Origin; from the back of both condyles, and by means of
from the heads of tibia and fibula, all round.
Insertion; *tendo Achillis.*

16. *M. tibialis posticus*, ... 0
Origin; from the back of the tibia, below the poplitæal li
from the interosseous membrane.
Insertion; into the scaphoid bone, by tendon round inner a

17. *M. flexor digitorum communis*, ... 2
Origin; from the whole length of the back of the fibula and
osseous membrane.
Insertion; by tendon passing round inner ankle, and afte
distributed to toes.

18. *M. flexor hallucis*, ... 0
Origin; from the oblique poplitæal line on back of tibia an
the head of fibula.
Insertion; by tendon passing round inner ankle, into the ten
the last; and dividing into branches to the toes which ino
with those of the common flexor.

19. *M. poplitæus*, ... 0·

20. *M. tibialis anticus*, ... 0·
Insertion; by tendon in front of ankle, into the base and
metatarsal of hallux.

21. *M. extensor hallucis*, ... 0·
Origin; interosseous membrane, and inner edge of fibula.
Insertion; by tendon in front of ankle, into outer side of
metatarsal of hallux.

22. *M. extensor digitorum communis = extensor medii digiti*, . 0·
Origin; head of tibia, and head and upper third of fibula.
Insertion; by a tendon in front of ankle, into the distal end
metatarsal of the middle toe.
[There is also a rudimentary *extensor brevis.*]

23. *M. peronæus longus*, ... 0·68 oz.
Origin; from external condyle of the femur, and by means of fascia, from the head of the fibula.
Insertion; by a tendon passing over the outer groove on the upper surface of the os calcis, and thence outwards, downwards, and inwards to the under sides of the tarsal ends of the 1st and 5th metatarsal bones.
This muscle assists the flexors in the feathering action of the great toe in swimming.

24. *M. peronæus brevis*, ... 0·56 oz.
Origin; outer side of fibula.
Insertion; by means of a tendon passing over the inner groove on the upper surface of the *os calcis*, and thence outwards and downwards to the outer side of the tarsal end of the 5th metatarsal bone.
The fibres of this muscle are blended with those of the *flexor digitorum communis;* and it acts as a pure abductor of the little toe, in the plane of the tibia and fibula.

PART III.—MUSCLES OF MASTICATION.

1. *M. digastricus*, ... 0·72 oz.
2. *M. masseterieus externus*, ... 0·33 oz.
The external fibres are directed upwards and forwards.
3. *MM. temporalis et masseterieus internus*,. . . . . 1·83 oz.
The temporal muscle cannot be separated from the internal fibres of the *masseter*, which are directed downwards, and somewhat backwards.
4. *M. pterygoideus internus*, ... 0·33 oz.
The fibres of this muscle are parallel to those of the external *masseter.*
5. *M. pterygoideus externus*, ... 0·03 oz

MONDAY, JUNE 27, 1864.

The REV. JOHN H. JELLETT, A. M., Vice-President, in the Chair.

Sir WILLIAM WILDE, read a paper

ON THE ANTIQUITIES AND HUMAN REMAINS FOUND IN THE COUNTY OF DOWN, IN 1780, AND DESCRIBED BY THE COUNTESS OF MOIRA IN THE "ARCHÆOLOGIA," VOL. VII.

IN the autumn of 1780, the body of a female, clothed in antique woollen costume, was discovered in a bog, at the eastern foot of Drumkeragh Mountain, in the barony of Kinalearty, and county of Down, the circumstances attending which, as well as the character of the costume, have been described by the distinguished Countess of Moira, in a letter, forwarded to the Society of Antiquaries in London, in 1783. That communication has been long known to Irish antiquarians, and appreciated for its learning and patriotism; and I myself and others have often regretted that that remarkable discovery had not taken place in our own times, so that an opportunity might have been afforded us of examining the costume, or procuring it for the Museum of the Academy. Owing, however, to the liberality of one of our members, the Earl of Granard, the great-grandson* of the original describer of these remains, I am now enabled to present to the Museum of the Academy the great bulk of the articles which came into the possession of Lady Moira nearly eighty-four years ago. From an examination of some of these specimens, it is manifest that a series of "Warp lifts," supposed to be a comparatively modern invention, was in use in Ireland when these articles were manufactured.

In the memoir in the "Archæologia" it is said that the human figure referred to was found buried in hard gravel, beneath $4\frac{1}{2}$ feet of bog, "and that upon and about the bones there were many garments." It was also stated that the circumstances under which the body was found showed evidences of burial; and also that the bog had been some years previously nearly eleven feet deep in that spot. I have, however, been by long experience so accustomed to receive with great caution all accounts of such matters afforded by the peasantry, even where a shorter interval has existed between the discovery and the recital than that recorded by Lady Moira, that I think we must receive with caution details of that nature.

No. 1.

The hair of the individual was long, silky, and of a deep chestnut colour; but how far this brownish-auburn tint is the original shade of the hair, or the result of the bog colouring, is questionable. Its present hue would be much coveted in our own day. The plait was formed of three strands, interwoven after the manner depicted in the adjoining woodcut, and closely resembles the mode of wearing the hair in vogue among children and young girls a few years ago. The entire plait is now fourteen inches long.

All the articles of costume described by Lady Moira were woollen—thus indicating that at the period to which they refer there was no linen or other vegetable fabric employed in that part of the country. What their original colours may have been it is now difficult to determine; but at present they present several varieties of brown, from a dark orange, through the various shades of russet and sienna, to a colour almost black. More, however, may be gleaned from the texture, and manufacture, and pattern of the fabrics, than from the colour. All the seams and hems are made good with woollen thread of the same colour as the texture which they joined; and as there are some evidences of patching and mending, we must conjecture either that the materials were obtained with difficulty, or that the person was of inferior rank. In fineness, as well as quality and pattern, they vary exceedingly. Ten specimens have been preserved, and each differs from the other in colour, grist of thread, and arrangement in weaving. Some of them were evidently the chief garments of the person, and were intended for warmth and protection, while others appear to have been of a decorative character. The accompanying illustrations represent the most remarkable of these patterns.

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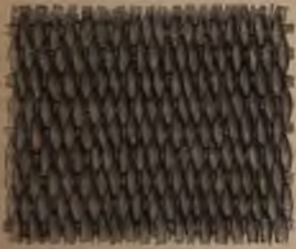
* Lady Elizabeth Hastings, Baroness Hastings and Hungerford, &c., in her own right, and Countess of Moira, was mother to Lady Selina Rawdon Hastings, Countess of Granard, from whom the present Earl inherited those portions of costume and hair referred to in the text.

No. 2.



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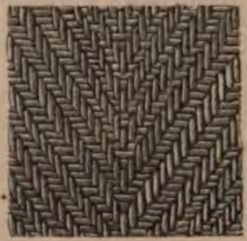
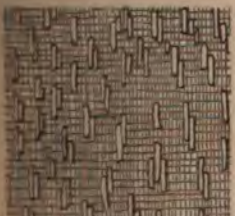


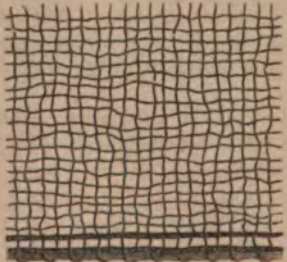
No. 2, accurately figured in this engraving, is a coarse camlet, probably the petticoat, in which the threads of the weft are hard and well twisted, but those of the warp are much thicker and softer. They intermingle, not as in a homogeneous piece of weaving, like modern cloth or linen, but having the warp standing in high relief, so as to present a corded surface, like that which is known in modern phraseology as "rep," and which is not unlike coarse Egyptian linen.

No. 3 is of a finer quality, but nearly of the same colour and closeness. The pattern is what is termed herringbone, and the weaving superior in quality to the foregoing. The portion under consideration has been much patched, and a piece of the same manufacture forms a patch upon the long strip of the following.

No. 4.



No. 5.

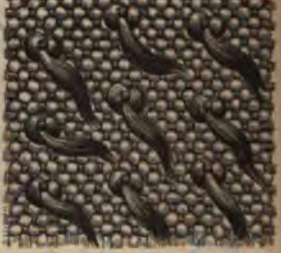


No. 4 is a thin, loosely woven, and open huckaback, as shown in the foregoing cut; it has a broad thick hem running along the edge; i colour it is nearly of a tint with the two preceding patterns.

Somewhat like No. 2, is a beautiful soft fragment, with a diape twill, and of a light warm colour, partaking of a shade of orange. I probably formed a part of the cloak or mantle. Of the same colour, but of a light serge texture, there is a small fragment of woollen stuff still remaining; likewise some portion of cording, apparently used in tieing or confining the dress.

The two remaining articles are of extreme interest. One of these, No. 5, is evidently a fragment of a light gauzy woollen veil, of the most delicate texture, and which it was believed by Lady Moira was of a greenish colour when first brought to light. The other, No. 6, is a piece of very closely woven hard firm thick mohair camlet of hair, not wool, and having on its outer surface rows of elevations, from each knob of which depended a small black tab, so that originally the cloth must have presented an ermine appearance. The colour is now a reddish-brown, but the remains of the tabs are quite black. This may have been part of the tunic. Even during the present century ladies' cloaks, tippets, and pellerines, and gentlemen's dressing gowns, were ornamented with ermine-like appendages of this nature.

No. 6.



The Rev. Samuel Haughton, M. D., F. R. S., Fellow of Trinity College, Dublin, read a paper—

ON AN APPROXIMATE METHOD, FOUNDED ON OBSERVATION, OF DETERMINING THE DAILY EXCRETION OF UREA IN HEALTH AND DISEASE.

The researches of chemists and physiologists, in recent times, have demonstrated that all the nitrogen received by the body in food is eliminated by the kidneys; and that the supposition that the skin or lungs contribute, except in very small proportions, to this elimination, is erroneous. This important fact, based upon very accurate experiments, would seem to render more necessary than it is considered usually to be the determination of the amount of Urea excreted in health and disease.

To find the Urea in a given liquid, requires a combination of qualities and circumstances that can only rarely occur to the practical physician.

1. He must be a good chemist.
2. He must have a chemical laboratory at his disposal.
3. He must have thirty-five minutes to spare on each case in which he determines the Urea by Liebig's nitrate of mercury process.

PR F UREA IN GR

SPECIFIC

	1003	1004	013	1014	1015
20	35	36	130	136	142
21	37	38	136	142	149
22	38	40	143	149	156
23	40	41	149	156	163
24	42	43	156	163	170
25	43	45	162	170	177
26	45	47	169	176	184
27	47	49	175	183	191
28	48	50	182	190	198
29	50	52	188	197	205
30	52	54	195	204	213
31	54	55	201	210	220
32	55	57	208	217	227
33	57	59	214	224	234
34	58	61	221	231	241
			227	238	248

ditions, the coexistence of which in practice is impossible,
d practising physicians in modern times from paying that
ion to the urine of their patients that was customary in the
of medicine.

mpanying Table, which is founded on many observations of
health and disease, of specific gravities from 1003 to 1028,
what I believe will prove a very useful approximation to
retion of Urea in all cases in which sugar is absent, and
r absent, or only present in small quantities.

e is one of double entry, to be used in finding the daily
urine in fluid ounces, and its specific gravity determined
graduated urinometer.

it with confidence to the test of practical experience, as I
tested it myself in fever, in pneumonia, in dyspepsia, and
eases, that I believe it will be found a most valuable aid to
, both in the prognosis and in the treatment of these and
.

, Ph. D., read the following paper:—

RY OF NEOTINEA INTACTA (REICHENBACH) IN IRELAND.

NATURAL ORDER—ORCHIDACEÆ.

TRIBE—OPHRYDINEÆ.

Section—LOROGLOSSUM.

Genus—NEOTINEA (Reichenbach).

Species—*intacta*.

—*Aceras intacta* (Reich.). Ic. 13, p. 2.
Orchis intacta (Link.), in "Schrader Diar." p. 11 (1799).
Satyrium maculatum (Desf.), "Fl. Atlantica," 2, 319.
Orchis Atlantica (Willd. Sp.), 4, 442.
Aceras secundiflora (Lindley), "Bot. Reg.," t. 1525.
Perystylus densiflorus (Lindley), "Orchid." 298.

—This highly interesting addition to the British and Irish
iscovered, in May, 1864, growing on the dry calcareous
astle Taylor, county of Galway, by Miss More.

IONS.—When Dr. Lindley described and figured this plant
anical Register," he remarked that it had an unusually
graphical range for an Orchis; the present discovery, how-
the range very considerably, and is highly interesting,
y, when viewed in connexion with some other plants
in the neighbouring counties of Kerry and Mayo. In those
well known that several plants which are typical of the
pe Flora, and also of the Flora of North America, appear,

though not found elsewhere in the British Isles: they seem to form the solitary outlying posts of the geographical distribution of the plants belonging to those Floras.

In Cork, the pretty Orchid, *Neottia gemmipara* (Smith) grows, which at one time was considered to be confined to Ireland, but has since been found to be a North American species. Again, in the county of Galway, the pretty aquatic plant, *Naias flexilis*, another plant of the North American Flora, occurs. In Kerry several of the *Saxifragæ* of the Pyrenees appear, and several of the Pyrenean *Ericaceous* plants extend from Kerry, through Galway, to Mayo; but stop there, and are not found further to the east, south, or north of this island.

Sir W. R. Hamilton, LL. D., read a paper "On some recent Geometrical Results of the Quaternion Calculus," including some which he had mentioned within the last year and a half to the Academy, but of which he had not yet supplied sufficient abstracts to the "Proceedings."

The following donations were received:—

"The History of Dundalk and its Environs," by John D'Alton, and —— O'Flanagan, Esqrs., presented by the authors.

"The Martyrology of Donegal," presented by the Council of the Irish Archæological and Celtic Society.

From J. J. Lalor, Esq., an early noble of Edward IV.

Sir W. R. Wilde presented the following antiquities:—

On the part of Dr. Gray, of Drogheda, a specimen of ancient armour; a small gold fibula; and the remains of a harp which had been found in connexion with them.

On the part of Edmond O'Flaherty, Esq., the cuticular portion of the horn of a short-horned ox, which had been found several feet deep in a bog at Oughterard.

On the part of the Rev. P. Langan, a yellow flint arrow-head, found near The Naul, in the county of Meath.

Captain Meadows Taylor read the following

CATALOGUE OF INDIAN MUSICAL INSTRUMENTS, PRESENTED BY COLONEL P. T. FRENCH.

Having been called upon to describe the valuable Collection of Musical Instruments of India, presented by Colonel P. T. French to the Academy, I will now proceed to do so, in the order in which they have been numbered. I have to regret that I have not been able to tune any of them: had this been possible, their uses and effects would have been much more readily understood than they can be by mere description; but the greater number of these instruments require steel wire strings of a quality made especially for them by wire-drawers in India, which is not obtainable in this city. I have therefore to depend upon descriptive detail alone, with notices of the uses to which they are put by native musicians of India, according to my own experience.

Nos. 1, 2, 3, IN CATALOGUE. NATIVE NAME झंञ (*Jhanj*).—METAL CYMBALS, OF VARIOUS KINDS.

These are used as accompaniments to all native music; but in the north more frequently in connexion with that of a religious character than in the south, where in all shapes they are universal. The larger kinds, whether of silver or of bell metal, when clashed together have an effect similar to those in use in our own military bands, and form fitting unison with the hoarse bray of trumpets, the shrill pipes and flageolets, the drums, and large choruses of male voices, by which the temple music, chaunts, hymns, and the like, is generally executed. Cymbals differ in form and sound: some have the effect of large gongs; others, of a softer and more tinkling character, are used with softer music. In all, however, the effect for the most part is to assist in marking the time, which is done very skilfully and evenly by the performers.

In the south of India another kind of cymbal is used, which is in the form of two cups, of bell metal, and of which there is no specimen here. Of these one is held in the left palm, secured by a cord passed round the hand, and is struck by the other, which is held loosely in the right. Players on these cymbals are extremely dexterous, and produce a not unpleasing accompaniment to the voice, or to instrumental music, by striking the cups together in such a manner, outside, inside, and upon their edges, as to form notes in accordance with the voice, or the other instruments by which it may be accompanied. This cymbal accompaniment is played with more execution than may be conceived possible from the nature of the instrument. I have heard *professors* even play solos upon it, which, if not very intelligible as to tune, were at least curious in execution and diversity of *time*, as suited to the various styles of music. Cymbals are used both by Hindu and Mahomedan musicians.

4. थाला (*Thalla*).—GONG.

This needs no particular description. It is beaten in temple music, or as calls to sacrifice or ceremony at different hours of the day, and is used by many of the professional religious mendicants of the country, more especially those who are accompanied by bulls or goats which perform tricks. The thalla or gong, is not used as an accompaniment to vocal music, nor to any but the loud, crashing and generally dissonant music of temple ceremonies. It is not used by Mahomedans except when struck as a clock, noting the hours of the day as shown by the water-clock or hour-glass, and in this respect indeed it is common both to Hindus and Mahomedans.

5. घंटे (*Gunté*).—BELL.

As a musical instrument, the bell is used somewhat in the same manner as the cymbals before mentioned, but more rarely. No ceremony of sacrifice or oblation, however, is ever performed without preliminary tinkling of the bell, which is repeated at certain intervals according to the ritual. No set of sacrificial utensils is complete without one. To describe the use of the hand bell at particular periods of ceremonial observance, would lead me into digressions which have no reference to the subject in hand; but there can be no doubt that the practice of using it is as ancient as Hinduism itself, and the rituals, liturgies, and works on ceremonial observances, define the use to be made of it. By Mahomedans, the use of the bell in any form that I am aware of is unknown.

6. घुंगुरू (*Goongooroo*).—ANKLE BELLS.

These strings of small bells are used by all dancers, male or female, Hindu or Mahomedan. They are tied round the leg, above the ankle, and produce a faint clashing sound as the feet move in steps, which mingles, not unmusically, with the dance music, or songs which accompany the dance; and they not only serve to mark the time, but to keep the dancer or singer in perfect time and accord with the musicians. These bells are the symbols of their profession with all dancers and singers, and to some extent are held sacred. No dancer ties them on his or her ankles before performance, without touching his or her forehead and eyes with them, and saying a short prayer or invocation to a patron saint or divinity, Hindu or Mahomedan. Nor is it possible, after a female singer or dancer has once been invested with them,—a ceremony which is very solemnly performed, and attended with much cost,—to abandon the professional life so adopted. He or she "has tied on the bells," is even a proverb, to signify that the person alluded to has devoted himself or herself to a purpose from which it is impossible to recede. Strings of these small bells are also used for horses, and tied round the fetlocks of prancing chargers with gay tinsel ribbons or pieces of cloth, also round the necks of lapdogs, and some of a large size round those of a favourite plough or cart bullock. The latter are identical with sleigh bells. No post runner in India travels without a string of them tied on the end of his pole on which is slung the leather bag he carries; and on a still night their clashing sound, besides being heard at a great distance, serves to scare away wild beasts, and to cheer the runner on his lonely path.

7. शिंग (*Seeng*).—HORN.

Used universally through India for signals, watch setting, processions, and the like, both by Mahomedans and Hindus, though the performers, for the most part, are Hindus of low caste. In every village of central or southern India, it is the business of one or more of the watchmen to blow the horn at sunset, and again at certain hours during the night, or when the watchmen go their stated rounds. In large cities every *mahulla* or ward has a horn blower attached to its night watchmen or police; and there is seldom a guard or detachment of native irregular troops without one. In all processions, temple services, and especially at marriages and other festive occasions, this horn is indispensable; and wailing blasts for the dead are played upon it at the funerals of Hindus of the lower classes and castes, or equally so at the cremations of Hindu princes.

No native authority traverses the country without one, frequently several, in his train; and as towns or villages are approached, the great man's advent is heralded by flourishes of the instrument, blown by the performer, who struts at the head of the cavalcade. These blasts are answered by others from the town or village gate, whence the local authorities come out to meet the visitor and present their offerings of welcome. On these occasions, the horn blowers on both sides vie with each other in producing their grandest effects, and the discordance is generally indescribable.

Itinerant mendicants of many classes use this instrument, both Hindu and Mahomedan; and by the men in charge of droves of cattle carrying grain or merchandize, such as Brinjarees, Comptees, and others, it is sounded at intervals along the road to cheer up their bullocks and keep them from straggling, as well as at their departure from or arrival at one of their stages.

In tone a good Seeng, or horn, is not unlike a common bugle, but has much more power, and in the hands of a good player much more compass. In playing the high notes in many of the calls, shrill quivering cadences are produced, which have a startling and peculiarly wild effect as heard from the walls of some ancient fortress, or from village towers and gates as night falls, and more especially in the otherwise unbroken stillness of night.

I have never heard tunes played or attempted by native horn-blowers, though the modulations of the tones of the instrument are frequently sweet and pleasing; nor are they used in concert with other music, but always independently, as I have already explained. There can be no doubt, I think, that this kind of horn is of very ancient origin and use; and I observe in the Museum of the Academy one ancient Irish or Celtic instrument, if not indeed others, identical with the Indian seeng, and which, like it, were most probably used in battle, or for the purposes already detailed. In shape, in the peculiar adaptation of their joints, and in the form of the mouth-piece, they are identical.

8. तुतुरि (*Tootooree*).—SMALL TRUMPET.

Used chiefly in religious music at temples, and in other religious ceremonies. It always accompanies the next in order, and may be called the tenor trumpet, the other being the bass. No calls or modulations are blown upon it, but it is sounded at intervals, several being employed, with a wild shrill effect, in concert with the pipes on which the tunes are played.

9. कॅर्ना (*Kurna*).—LARGE TRUMPET.

Like the preceding, this is used chiefly in religious processions, or in festivals in honour of local divinities. It has a few hoarse bass notes, which contrast with the shrill tenor of the Tootoree, and appear incapable of other modulation. These instruments are almost invariably played by Brahmins or priests attached to Hindu temples, and by persons attached to the retinues of the Gooroos, Swamies, or spiritual princes of the country, who possess large ecclesiastical jurisdiction, and are provided with them, as a mark of high rank, which is not allowable to others. Occasionally, also, they are met with in the Nobuts, or musical establishments attached by royal permission to nobles of high rank, Mahomedan as well as Hindu; and they are sounded at the five stated periods of the regular daily performance; but they do not exist in all cases,—for there are distinctions in the classes of instruments, according to the rank of persons privileged to play the Nobut, which involve the presence or otherwise of the *kurna*, those of the highest rank only being able to use it. The Nobut, as a peculiar institution of native music, will be explained hereafter. The *kurna*, or large trumpet, is esteemed by all Brahmins to be the most ancient instrument of music in existence, and the sound of it to be especially pleasing to the gods, in various particular ceremonies, and at solemn parts of sacrifice. I need not, however, occupy the time of the Academy with such legends.

It is perhaps worthy of remark, however, that in the procession on the Arch of Titus at Rome, one of these trumpets, precisely similar in shape to that of this collection, is being carried with the sacred candlestick with seven branches, and other trophies from the Temple at Jerusalem; and thus it may be inferred that it was used in the ancient Jewish ceremonies.

10. होलार चा सुनाडे (*Holar cha Soonai*).—11, 12. *Do. Tenor or Second.*—REED PIPES.

These instruments, which all belong to the same class, are of universal use in all parts of India. What bagpipes are to Scotland or Ireland, these pipes are to India. Although flageolets in appearance, their sound is precisely similar to that of the bagpipes, only perhaps more powerful, and in the hands of good players more melodious. They have seven and eight holes, respectively, and thus would appear to have no great compass; but in execution, whether from the effect of the lips and tongue upon the reed mouthpiece, or the manner of fingering upon the holes, combinations are formed which include semitones and quarter notes, and thus the expression of chromatic passages *ad libitum*, of which native players are very fond, is given, which, in reality, are very effective. From their great power of sound, these pipes are unpleasant if the performers be near; but at a distance in the open air, and especially among mountains, the effect is much subdued, and often attains much wild beauty and softness. As I have already stated, their use is almost universal. They are, in fact, the only regular out-door instruments of Indian music, and are employed on all occasions, whether in domestic or public religious ceremonials, processions in festivals, temple music, and the like; and the music played upon them varies with the occasion on which they are used. Marches, and military music exceedingly like pibrochs in character—pieces for marriages, for rejoicings, for funerals, welcomings, departures—familiar ballad airs, and the stated music of the Nobut, have all separate modes and effects. In the Mahratta country, in which I know them best, the simple melodies of the people, joyous or plaintive, are performed with a style of execution which is often surprising; and combinations of musical effect are introduced which are equally curious and interesting.

In the Nobut, or honorary band of musicians attached to noblemen, temples, or shrines of saints Mahomedan or Hindu, the best performers obtainable are generally employed; and the performance is accompanied by drums, tenor and bass, and large kettledrums, which are tuned with the pipes, and form useful aids to the general effect. The music played is generally traditional, as no written music is ever played from; but skilful players not unfrequently invent new airs, which are founded upon the several modes of recognised divisions of music, and these are taught to pupils, thus perpetuating continual changes, whether for different hours of the day or night, or for extraordinary occasions. Not unfrequently, very sweet-sounding flageolets are used by Mahratta musicians in company with these pipes, which have the effect of mollifying their shrillness; but I do not find any specimens of them in this collection.

In the Mahratta country the players of these pipes are called *Gursee*, and the office of piper is hereditary in every village or town, accompanied by portions of land, and certain proportions of the crops of the village at harvest, and other hereditary dues and privileges, in common with other members of the hereditary twelve village councilmen. The office of "Gursee" involves sweeping the village temples, lighting the lamps, and officiating at certain ceremonies; and on all occasions of marriages, festivals, funerals, and the like, the Gursee is entitled to certain perquisites, the rights to which are strictly preserved and universally admitted.

14. होलार चा सुर. 15. (*Hoolar cha Soor*).—TENOR AND BASS DRONES.

The pipes are invariably accompanied by drones, tenor and bass, or first and second bass, of which Nos. 14 and 15 are specimens. These instruments have but one note each, which is played without intermission by different persons. They have the exact effect of the drones of bagpipes, and can be tuned to any key which the leading instruments require, by altering the position of the mouthpiece or reed, and the pipes are tuned to different keys in the same manner.

16. पुंगि (*Poongi*).—SNAKE CHARMER'S PIPE.

These instruments have six notes, and three semitones. Simple, plaintive airs, generally in minor keys, can be played upon them; but they are not used with other musical instruments, and belong exclusively to the snake charmers and various tribes of jugglers, acrobats, and the like. By the snake charmers, a few notes only are played, which seem to have the effect of rousing the snakes to be exhibited, usually cobra di capellos, to action; and as the reptiles raise themselves on their tails, expand their hoods, and wave themselves to and fro, the players become more excited, while the motion of the snakes is accelerated by the rapidity of their execution. So also in feats of jugglery, or sleight of hand, the *poongi*, accompanied by a small hand drum, seems to assist the performer, especially when throwing knives or balls into the air, catching them in succession, and throwing them up again.

I think there is no doubt that the tones of this instrument have an effect upon all snakes, especially cobras, though this is denied by many. As an instance of this I may mention that one very large cobra, which frequented my garden at Ellichpoor, and of which every one was in dread, was caught by some professional snake charmers in my own presence by means of the *poongi*. It was played at first very softly before the aloe bush, underneath which the snake lived in a hole; gradually the performer increased the tone and time of his playing, and as the snake showed its head, he retreated gently till it was fairly outside, and erected itself in a defiant manner. At that moment another man stepped dexterously behind, and, while the snake's attention was absorbed by the player before, threw a heavy blanket upon it, seizing it by the head under the jaws. The head was then pinned down by a forked stick, and the fangs and teeth extracted by strong pincers. The snake was then turned loose, apparently completely cowed and exhausted, and finally transferred to a basket for education as a performer. There was no mistake as to the identity of the reptile; for a portion of its tail had been shot off in an attempt to destroy it. The same men afterwards drew snakes from the thatch of my house, all of which seemed to obey the fascination of the pipe.

17. सुरसोटा (*Soor Sotta*). 18. तांबुरा (*Tumboora*).

19. *Do.* 20. *Do.*—FOUR-STRINGED LUTES, LARGE AND SMALL.

The four instruments, 17 to 20, are called *soor sotta*, or *tumboora*, and are only variations of the *tumboora*. They consist of a large gourd as a body, and a stringboard without frets, with pegs at the end, along which the wires, one brass and three steel, are stretched over a bridge, below which each string is fitted with a glass bead, which improves the tone and assists in tuning. No performance of varied character is made on these instruments. They are tuned to one chord, in whatever key is required—generally of C—and the finger passed rapidly across the strings: or the notes are played separately, but quickly, so as to form the chord in vibration.

Almost all Hindu and Mahomedan singers use these instruments in preference to any other. They are, in fact, only helps to the voice, and afford a simple accompaniment, which marks the time, while it does not interfere with the singer's execution. So much ornament is employed by professional native singers, that they prefer to rely upon their vocal powers alone for success; and it is esteemed a mark of inferiority to use any other adventitious aid than the simple chord of the *tumboora*. In most instances the singer plays himself, though I have occasionally seen two or three instruments, of different sizes and tones, employed where the singer was sure of correctness of time and accord. The *tumboora*, therefore, is confined to the use of singers, male or female, or to accompaniments in recitations, the chaunting of sacred works and hymns, and of scales and exercises in singing. It is never used in company with pipes or flageolets, or indeed with any other instruments; but, as I have described it, the effect is simple, and often very charming when a good instrument is used which has a mellow tone.

21 क्षितार (*Sitar*). GUITAR, OR LUTE, FOR PERFORMANCE.

The *sitar* is another instrument expressly intended for the performance of pieces of music, though I have heard it used occasionally by Rajpoot minstrels as an accompaniment to the voice. It has five wire strings, three steel for treble, and two brass for bass, and eighteen frets, or, with the nut, nineteen; and it will be seen by a glance, that its capability for execution is considerable, though the metallic strings always produce a jangling effect, which is unpleasant. The *sitar* can be altered to any key by moving the frets up or down, and a skilful musician knows how to do this exactly. The execution with which it is frequently played is wonderful, and the performer can execute chromatic passages at will, extending to fourths of original notes.

22. सुरशृंगा (*Soorsringa*). 23. कछवा (*Kuchwa*).

Numbers 22 and 23 are instruments of the same character as 21, for performance only—23 differs from 21, not only in respect to its size and power, but in having two strings only to play upon, tuned in thirds, from strings in the centre, which are tuned to the chord of the key or primary note; and two smaller strings at the side, which represent a high octave, and can be struck as necessary. In playing, the chord in the centre is not always struck, but only occasionally for effect. This instrument, which is difficult of execution, is not often met with. 22 has only sixteen frets, but eight strings, six from the top and two at the sides, which lie under those played upon, and are used in combination with them for peculiar resonant effects. This variation of No. 21 is, however, uncommon, and confined perhaps to the Guzerat country.

24, 24A, 25. **तााउसि** (*Taoosee*).

This is another variation of the sitar, No. 21. No. 24 has seventeen frets, with six playing strings; but below them are eleven strings of very fine steel wire, which are tuned to eleven separate notes in the direct scale, and are not played upon. Their use is to effect modulations by vibration of sound, which imparts softness to the melodies executed by the hand. No 25 is an instrument of the same character, but with twelve lower strings, which are tuned as in the preceding, and with the same object.

The Vina.—The best instrument, however, and the most powerful and melodious of this character, is the *vina*, which is wanting to this collection. In form it does not differ much from the preceding, but it has much more power and sweetness, though the peculiar effect of notes sounded upon brass and steel strings is never absent. The finger board of the *vina* with nineteen frets is 2½ octaves, and the frets themselves represent the following notes in English music :—

D, D#, E, F, F#, G, G#, A, B#, C, C#, D, D#, C, F, F#, G#, A, D.

To hear, so as to understand, any really classical Hindu music, it should be played upon this instrument; and I have occasionally met with some very learned and accomplished performers, principally from Mysore and the south of India. One of these men, after playing many Hindu airs and variations upon them, changed the key of the instrument, and began a piece which was familiar to me, though from *him* unaccountable; it was, in fact, a great portion of Beethoven's Sonata in A; and he explained that, having once taught an English lady a good deal of his own music, which she played upon the piano, she had in turn taught him this Sonata, which he preferred, he said, above all other "English Music;" and his version of it, considering the defects of his instrument, was really very beautiful. The fact of nineteen frets expressing the notes I have enumerated, and their extension according to the Hindu system of fingering, affords satisfactory proof of the capabilities of the vina, which is honourably mentioned by Sir William Jones in his Essay on Hindu Music, as the standard instrument of India.

26. **सारंगि** (*Sarungi*). 27. **सरोदा** (*Sarrooda*). 28. **चिकारा** (*Chikara*).

These are the ordinary violins or fiddles of India, and are played in the same manner, though differing from them in some respects, as the instruments in use with us. Of the three, No. 26, is the most commonly employed. 27, *sarrooda*, may be called the tenor or second fiddle, and accompanies 26 in chords, played by the bow, or by hand as a guitar. 28 is an inferior fiddle, which is mostly to be seen in the hands of strolling players, or mendicants, reciters of short plays or poems, and ballad singers. The *sarungi* has four strings of catgut; it is played with a bow; and the execution upon it by accomplished performers is frequently striking and pleasing, while the tones are nearer perhaps in quality to the human voice than those of any other instrument with which I am acquainted. Considering its small size and rude shape, the tone is much more sweet and powerful than would be conceived from its appearance, and this may be accounted for in two ways. First, that the sounding board is of parchment, stretched over the wooden frame; and, secondly, that below the gut strings which are played upon, there are eleven others of fine steel wire, tuned exactly with the scale, and thus the effect of the notes played is perhaps increased by vibration upon the wire notes beneath.

The *sarungi* is used by Mahomedan musicians more than by Hindu; and I imagine it may have been introduced into India by the Mahomedans, possibly from Persia. It forms an excellent accompaniment to the voice; and an old friend of mine, an excellent musician and violin player, the late Captain Giberne, Bombay Army, used to prefer one of these instruments to his own violin for concerted pieces in which the violin took a soprano part. The capability of the *sarungi* for the execution of chromatic passages and harmonies is, to some extent, equal to our own violin; but it would be quite possible to improve the native instrument without altering its character, and in such case it might prove a useful addition to our own orchestral effects.

From its size, the *sarrooda* is more powerful, but more difficult of execution; and it combines the effect of a guitar, as it is sometimes played in accompaniment, and the violin.

29. सारमंदल (*Sar Mundal*).

This may be styled the Indian dulcimer. It is by no means common, and therefore good execution upon it is not often met with, nor indeed at any time is it very pleasing, owing to the continual jangle of the wire strings.

30. बीन (*Been*),

Wire-strung guitar, which is chiefly used by mendicants and religious devotees in recitations, hymns, and other sacred singing. In some degree it resembles the *vina*, but has not its power or sweetness, nor indeed capability of execution. This instrument has twenty-three frets, and there are five strings to be played upon, with two others at the side for occasional effects.

31. **तुंतुंणि** (*Toontoonee*),

An instrument with one wire string, and of a rude character. It is invariably used by mendicants and common ballad singers in the Dekhan, and the wire is struck rapidly by the finger, or a quill, as an accompaniment to the voice. The string can be tuned to any key required.

32. **डफदे** (*Duffdé*). 33. *Do.* 34. **हलकया** (*Hulkya*).

35. **टायरा** (*Dayra*). 36. **डफ** (*Duff*).

These five instruments belong to one class, the common tambourine drum of India, which is played, partly by sticks, partly by the hand. The performer holds two long thin pieces of wood or twig in his left hand, which he rests upon the frame of the instrument, which is strung over his shoulder, while with the right he beats it with a short thick drumstick. The measure and tone can be changed and varied by the manner in which the notes are played by the sticks in the left hand, and in this respect the drummers are very expert. These instruments form the ordinary accompaniments to the horn, No. 7. Every village, or watch on town bastions, fort walls, and the like, has one; and in native armies the *duff* is beaten furiously on occasions of attack. In all sorts of processions, festivals, and the like, they are employed; but they do not aspire to the refinement of other drums of a more scientific character, which will be described in turn.

41. हुडुक (*Hoodook*). 42. डाक (*Dāk*).

These drums are used by ballad singers, mendicants, and the like, and need no particular description. The latter use them in concert with begging petitions in the name of some divinity, which are often sung to wild or melancholy cadences.

43. वाहया (*Bahya*). 44. जिल्ला (*Jilla*).—COMMON COPPER KETTLE DRUMS,

Which need no particular explanation; both are played with sticks. They are often found with small parties of village musicians, and in concert with pipes.

45. सबांल (*Sumball*).—TENOR AND BASS DRUM.

Of the same character as No. 40, Pukhwaj; but not so melodious in tone, nor so much used.

46. तबला (*Tubla*).

These drums, tenor and bass, rank with the pukhwaj, and are preferred by many players. They are tied in a cloth round the waist, when played, and the hands are exclusively used, with extraordinary execution. The tone is mellow and delicate, and, harmonized with the violins, forms an excellent accompaniment to the voice. The *tubla* drums are made of copper, and, while equally sweet, have perhaps more resonance than the *pukhwaj*, which is of wood.

Drum-playing on these instruments is quite an art among Indian performers. They mark the time, which is of a very complicated nature, and differs in many respects from ours, to suit the varied modes of the music. On this account, and from the very florid passages required, years of study and practice are required by the performers.

47. नल (*Nul*).—KETTLE DRUMS,

Generally used on horseback, much like our own, and beaten by sticks. In native cavalry, and in our own irregular cavalry regiments, they are carried in front on the march, and by their sonorous notes the line of progress is indicated to prevent straggling.

48. डुगडुगा (*Doogdooga*).—SMALL HAND DRUM,

Used chiefly by mendicants and ballad singers.

49. नोवत (*Nobut*).

This instrument, which is the largest kettle drum used in India, gives the name to the "Nobut," or honorary music before alluded to.

It has a deep, mellow sound, and is played and used much like our own bass drum. With it are usually associated the smaller kettle drums, 43 and 44; and a performance upon the drums alone forms part of every period of playing throughout the day, though they accompany the pipes and trumpets in all other music executed.

50. शंक (*Shunk*)—CONCH SHELL,

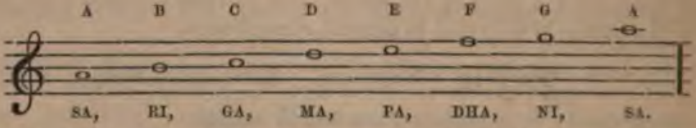
Is not used as a musical instrument, but is sounded during religious ceremonials, in processions of Hindu worship, and before idols. No tune, so to speak, can be played upon it; but the tone is capable of much modulation by the lips, and its clear, mellow, humming notes, heard at early morning and eventime from Hindu temples, and the groves about them, have a peculiar though melancholy effect, not without charm.

The above concludes the catalogue of these instruments; and as the foregoing details may be esteemed incomplete without some notice of Hindu music as a science, the following remarks upon it, brief as they must necessarily be, may serve in some respects to supply the deficiency. I do not put them forward as original; for it would be impossible for me, without a greater acquaintance with Hindu music than I possess, to write anything more complete than Sir William Jones's Essay, which gives details to a greater extent than those with which I can presume now to occupy the time of the Academy.

First, then, as to notation—we find the Hindu gamut to be in essentials similar to our own. There are eight notes in their scale, which form the foundation of the primary modes, or "Swaras," and which are named as follows:—

Sharja,
Rishaba,
Gandhana,
Madhyama,
Punchama,
Dhaivata,
Nishada.

of which the initial letters form the gamut:—*Sa, Ri, Ga, Ma, Pa, Dha, Ni, Sa,* corresponding with our *Ut, Re, Mi, Fa, Sol, La, Si, Ut,* and the Hindu scale may be thus written:—



But the Hindoos have adopted no especial symbols, like ours, to express sound or time; and in writing music, according to the ancient system, the air and time of the melody are expressed by lengthening or shortening the vowels attached to each initial consonant, and repeating the notes as they may fall together in the air.* This in itself, it will be admitted, is rude and unsatisfactory; but by certain signs, such as dots, curves, and other marks, the written notation becomes intelligible to performers; and as taught at present, the scales, and vocal and instrumental exercises of learners, some of which are extremely complicated and difficult, consist of repetitions of the primary notes of the gamut, in the time and tune intended.

Each note is divided into halves, thirds, and fourths, which are defined by signs and marks attached to the notes of the gamut, and can be expressed by the voice; or, taking the vina as the standard instrument, on and between the frets, by a manner of fingering known to performers and teachers; and the *sarungi*, or violin, can be used with similar effect.

Again, taking each fundamental sound separately, the classical definition or doctrine of sounds admits and defines seven variations to each, which become the leaders of a series of other modes. Thus we find 7 × 12 = 84 modes: seven primary, and seventy-seven secondary, which are known under their separate appellations. The requirements of the classical system are, that each melody formed upon any of the above primaries or other adjuncts should be complete in itself; and no deviation from this rule is recognised or permitted. The modes are distributed over the hours of the day and night; and no professor of Hindu music, or educated performer, would be held excusable by a critical audience, if he transgressed propriety so much as to introduce at a wrong period songs, or instrumental performances, which belonged to another.

In illustration of this rule, Sir William Jones observes:—"A melody, or phrase, commencing with

D. E. F♯ G♯ A. B. C♯ D.

where the first semitone appears between the fourth and fifth notes, and the second between the seventh and eighth, as in the natural scale; and the G♯ and C♯, or ga and ni, of the Indian authors, form our major mode of D:—such a melody must end with the fifth note from the tonic, and it would be a gross violation of musical decorum to sing it at any time except the close of day."

Another mode of division, which is perhaps more modern, is the division of the six primary notes into fifty-four modes, by an allegory. Bhairava, Malava, Sriraga, Hindola, Dipaca, and Megha, are six nymphs, each of whom is married to a Ragini, and each has eight children. Thus we have six nymphs, as primary notes; six semitones, as husbands; and forty-eight children, as minor modes or divisions; making fifty-four in all.

A third system divides the rágs or modes into six primary, and thirty secondary. Each of these is known by the note which begins it or ends it. As an example, the Sri raga corresponds with our major scale;

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* In like manner our own music might be written and read from the notes themselves.

Sa, or A, is its principal note, with Pa, or E, diminished by one "*sruti*," or part of a note. Thus, we find that this mode represents the ordinary scale, ut, re, mi, sol, fa, la, si, ut, with a minor tone, or three srutis, between the fifth and sixth notes.

I have mentioned in my descriptions of the instruments, that chromatic and enharmonic passages of great intricacy can be executed upon several of them—the *vina*, the *sarungi*, &c. This will be accounted for by the fact of the system of music prescribing twenty-two srutis, or divisions of notes, to each whole octave; or furnishing each note, or those which according to the requirements of the particular mode may need it, or the particular melody in the mode, with semitones, thirds, and quarters of notes, as may be necessary. It would seem, however, as if more than "twenty-two srutis" to an octave were inadmissible; and the notes to which any number of srutis is admissible is determined by the key note, or primary.

"Semitones," says Sir William Jones, "are placed as in our own diatonic scales, the intervals between the fourth and fifth and first and second are major tones; but that between fifth and sixth, which is minor in our scale, is major in theirs. The two scales are made to coincide by taking a 'sruti' from Pa, or E, and adding it to Dha, or F; or, in Indian terms, by raising Savaretna to the class of 'Santa,' and her sisters. Every sruti is a little nymph; and these nymphs, or srutis, or quarter notes of the fifth note, Pa, or E, are called, Malini, Chapala, Sola, and Savaretna."

In like manner, every note has its fairy attendants attached to it; and these being furnished with names, the separate portions of each are known at once, in their proper order, and without confusion, to scientific Hindu musicians.

There are many Sanscrit, as well as Teloogoo, Canarese, and Tamul works on music, still in existence. Indeed, in the south of India music appears to have been maintained, and cultivated as a science, long after it had ceased as such in the north. Mahomedan historians of the period relate, that when the Dekhan was invaded by Alla-oo-deen Togluk, in A. D. 1294, and the conquest of the south of India completed by the Mogul general, Mullik Kafoor, several years afterwards, the profession of music was found to be in a condition so far advanced of the north, that singers, male and female, musicians, and their Brahmin instructors, were taken with the royal armies and settled in the north. The works that remain on the subject have been examined by competent Oriental scholars, who have discovered that music as a science held a high place among ancient Hindus, and became the subject of learned, though pedantic, treatises on doctrines of sound, variations of scales, accord of musical instruments, divisions of modes, singing, and instrumentation; but no where does it appear that the laws of harmony had ever been discovered or invented; and, as a consequence, all Indian music is wanting in this most essential particular. This, and the pedantic divisions into modes, so jealously guarded from infringement, have prevented Hindu music and its science from that improvement and extension which have been attained elsewhere. In this respect music is, like all other sciences of the Hindus, and their philosophy, unprogressive and effete. In performance upon the *vina* or *sarungi*, the performer's ear, and the capabilities of the instrument, lead players into thirds, fifths, and octaves, with the laws of which they are unacquainted; but all singing and playing are in unison, and whether trebles, tenors, or basses, which are often joined, and in all instrumental music, the execution is of the same character. It is needless to say that this inevitably produces monotony, and causes Indian music to be generally uninteresting, if not repellant, to European ears.

I am bound to state, however, that very little of the really good or classical music of the Hindus is ever heard by European ears. What is ordinarily played to them is the commonest ballads and love songs, with modern Persian and Hindustani ditties, sung by ill instructed screaming dancing women, at crowded native durbars, marriages, and other ceremonials. The late Nawab Shumsh-ool Oomrah, of Hydrabad, for instance, used to cause from ten to twenty sets of dancers and singers to stand up together, each set consisting of several women as singers, and a proportion of instrumental performers. All sang and played together whatever they pleased, and the clamour of different tunes, with all their varied accompaniments, was quite indescribable. It is no wonder, therefore, that the English guests stopped their ears, and declared native music to be abominable. Need I say, that, were all the best singers and bands of Dublin to play the most beautiful music at their command at the same moment, the effect might even be more painfully hideous!

But music of much intrinsic beauty, nevertheless, exists; and the ancient râgs or modes, with their simple melodies, and the marvellously difficult, and often charming scales, *droopuds* and *laonees*, and other exercises of vocal and instrumental performance, and the plaintive and beautiful ballads of the Rajpoots and Mahrattas, would, I think, amply repay collection by one competent to make it. It would be a grateful gift to the musical world at large, were the government of India to undertake a complete collection and exposition of the best Hindu and Mahomedan music, as it exists in the north of India, in Rajpootana, and Guzerat, in the southern provinces, and midway in Maharashtra and Bundelkund. The music of all these provinces differs as much in character as national music in Europe, and there is a great deal of it that is very interesting. How many of the old râgs or modes are illustrated by love songs! and how many of the chivalrous events of ancient and mediæval times are subjects of ballads much like our own, descriptive, picturesque, and most original both in subject and music! In the Mahratta country, I can state of my own experience that ballads and love songs are innumerable, whether of the old Mahomedan period, the Mahratta risings against them, and the more recent English and Mahratta wars, and are full of local adventure and spirited description; while in all the grades of love songs, under their several local denominations, there are scores, nay, hundreds, in every province of India, worthy of being rescued from their present obscurity, and of being preserved among the musical records of the world.

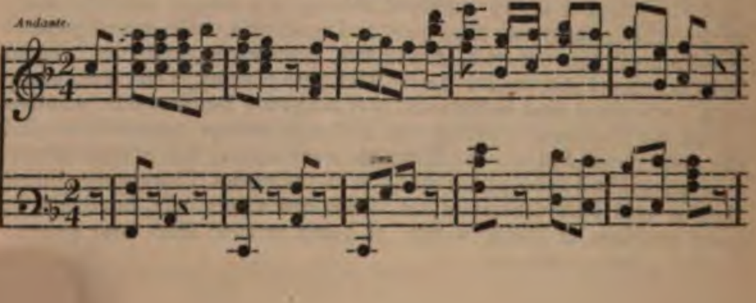
In his Essay, and to illustrate the manner of notation of the ancient Hindu system, Sir William Jones has quoted a very simple air of Soma's, who was one of the most ancient Hindu writers on music, and composers. This, with a few airs contributed by Colonel Tod, in his work on the Rajpoots, form nearly all the Hindu music now on record; and these, with some common tunes picked up from ordinary singing men and women at nautches, are the only specimens of Indian music now available for reference or comparison. There is much to be regretted, I think, in this, not only because national music is always valuable in an ethnological point of view, but because it would afford most interesting comparisons with the ancient national music of Europe, which it so much resembles. I venture to offer a very simple contribution,—a plaintive Hindu air of the most ancient class, to which I have adapted English words in partial paraphrase of the original Hindee, and to which one of my daughters has added enough accompaniment to admit of its being sung by a soprano voice to the pianoforte.

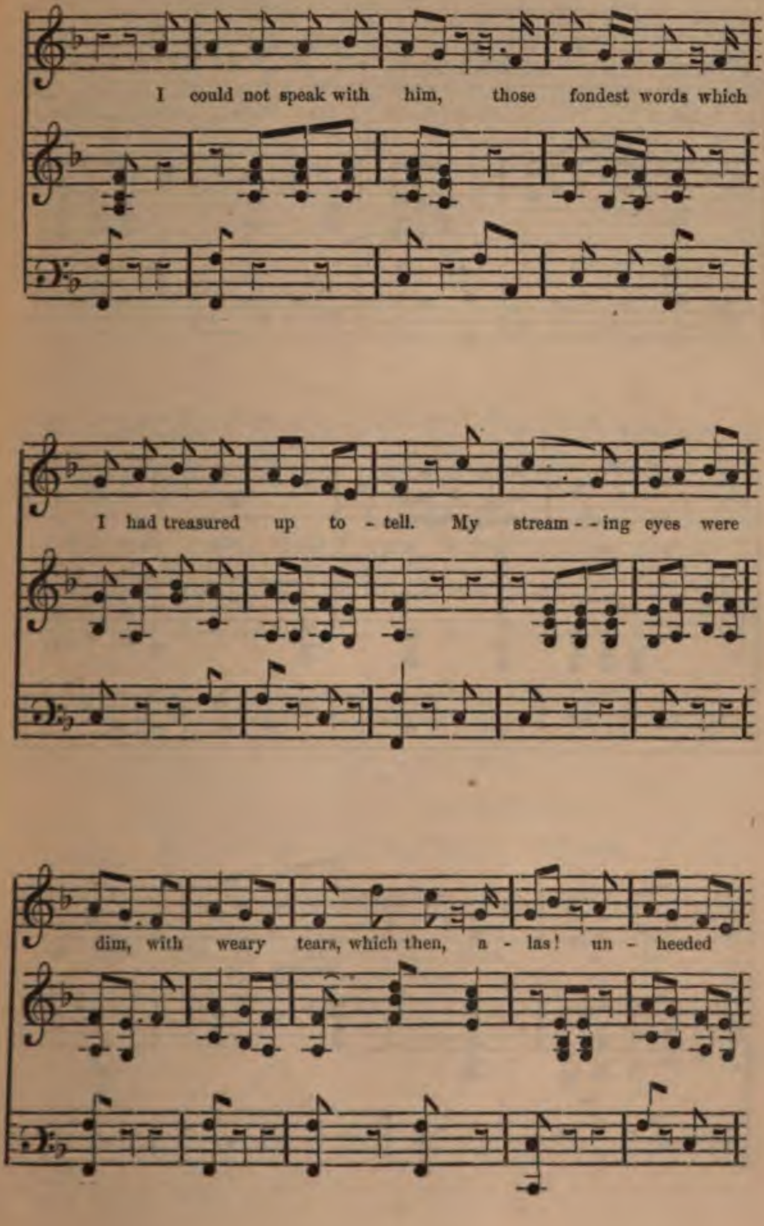
I cannot close this paper without adverting to the value and importance of this collection of musical instruments, which I consider to be unique. I have never seen so large a one in the possession of any native connoisseur, and my impression is that there is nothing so complete in any European museum. A few, and very few, instruments are wanting to make it perfect, and these might be easily supplied. On these grounds, therefore, I consider that this Academy is under peculiar obligations to Colonel French for his valuable donation,—valuable alike from its original cost and expense of transport, and as an illustration of the musical tastes and aquirements of India; and I have no doubt that suitable acknowledgment will be made to him.

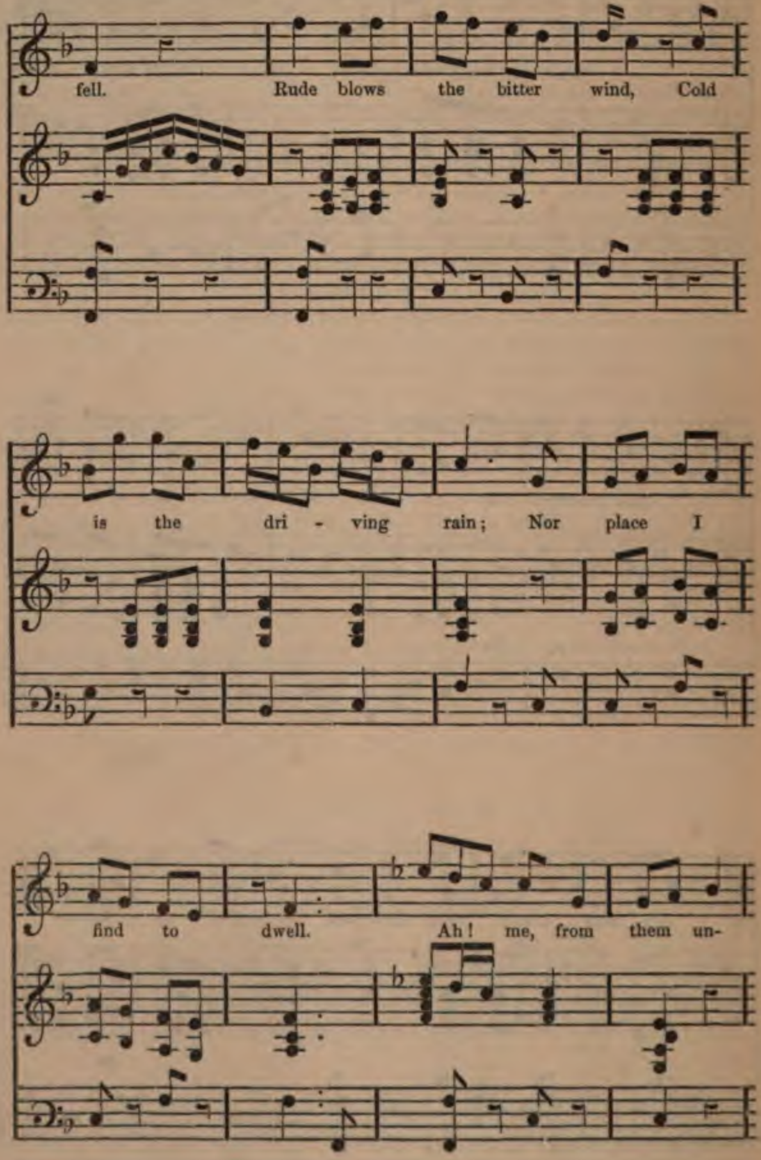
INDIAN AIR.

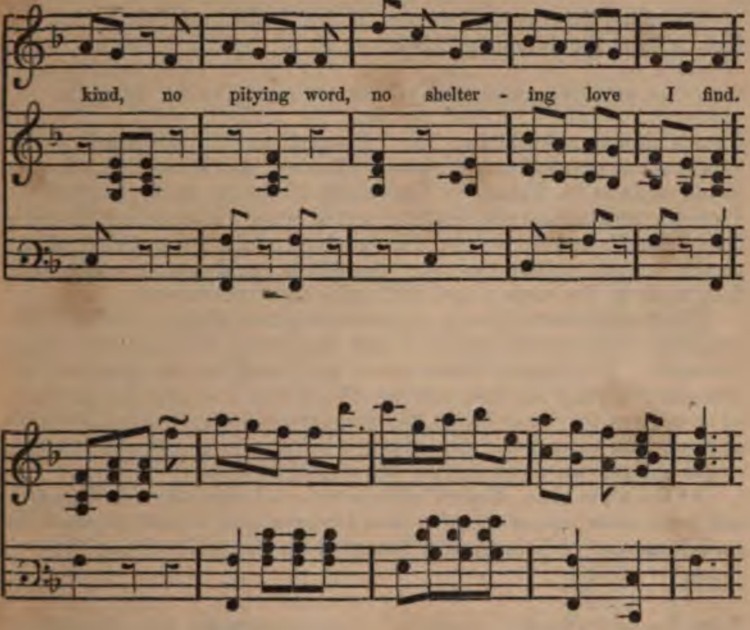
Kurna na paee bât.

Words by M. T., from Hindu Ballad. Accompaniment by A. M. T.




I could not speak with him, those fondest words which
I had treasured up to - tell. My stream - - ing eyes were
dim, with weary tears, which then, a - las! un - heeded


fell. Rude blows the bitter wind, Cold
is the dri - ving rain; Nor place I
find to dwell. Ah! me, from them un-



Ah! now I vainly cry
Dear lord, dear heart so fondly loved,
Thou would'st not see me lie
So desolate, nor fail that love so truly proved.
  Rest! rest, oh, breaking heart;
Peace cometh now to thee, that nought had ever mov'd,
  Ah! why delay thy dart
  Kind death—take me to him, that never more we part.

ORIGINAL HINDEE WORDS.

Kurna na pāee bát
Ah myn. Peea soo jeea ke bat
Oodowjee! tahreean, myn bulaeen leongi ho!
Mohe le'chulo oonhen ke pas.

The Rev. Samuel Haughton, M. D., Fellow of Trinity College, Dublin, read the following Paper:—

On the Evaporation of a Water Surface at St. Helena.

I have already published in the "Proceedings" of the Academy the results of one year's Observation on the Difference of Rain-fall and Evaporation made at St. Helena by Lieutenant Haughton, R. A., in 1860–61. Through the kindness of this officer, and of Major Phillipps, commanding Royal Artillery at St. Helena, I am enabled to lay before the Academy on the present occasion two years' Observation on Evaporation and Rain-fall, made at the same place, and under better conditions.

The former observations were made in a glass cylinder, 9 inches high, and 4·85 inches wide, and gave only the excess of Evaporation above Rain-fall. The present Observations were made in two cylinders, one circumstanced like the last, and the other placed in a large tub of water, so as to have the water inside the cylinder always surrounded by water at nearly the same level, thus giving a better approximation to the true evaporation from a water surface surrounded by water.

At the same time, Major Phillipps recorded carefully the Rain-fall; and from a comparison of both sets of Observations, I have obtained the actual amount of Evaporation, corrected for Rain-fall, during the two years.

Part I.—Lieutenant Haughton's Observations on the Difference of Evaporation and Rain-fall.

Observations on Evaporation resumed at 10^h 45^m A. M., on Sunday, 3rd August, 1862, with the old glass as before; and another, about the same size, immersed in water up to the zero point.

A is the depth of the water evaporated in one week in the new glass immersed in water.

B, ditto, in the former glass.

		Inches. *A*.	Inches. *B*.			Inches. *A*.	Inches. *B*.
August	10, 1862, . . .	1·00	1·80	October	5, ...	1·60	2·10
,,	17, ...	1·50	2·10	,,	12, ...	—	2·10
,,	24, ...	1·00	1·40	,,	19, ...	1·40	1·80
,,	31, ...	1·20	1·70	,,	26, ...	1·60	2·80
				Novemb.	2, ...	1·60	2·80
Sept.	7, ...	1·50	2·00	,,	9, ...	1·35	2·00
,,	14, ...	1·80	2·40	,,	16.	—	—
,,	21, ...	1·50	2·00	,,	23,†	2·10	3·55
,,	28,*	1·10	1·60	,,	30, ...	1·15	1·90

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* The level of the water is always below zero at the end of the week.

† For two weeks.

	Inches. A.	Inches. B.
Decemb. 7,[1] . . .	1.55	2·10
,, 14,[2] . . .	1·65	2·20
,, 21, . . .	1·45	1·15
,, 28, . . .	1·50	2·25
January 4, 1863, . .	1·55	2·50
,, 11, . . .	1·65	2·70
,, 18, . . .	1·10	1·75
,, 25, . . .	1·30	1·95
February 1, . . .	1·55	2·50
,, 8, . . .	1·40	2·30
,, 15, . . .	0·90	1·90
,, 22, . . .	1·40	2·45
March 1, . . .	1·40	2·25
,, 8, . . .	1·00	1·90
,, 15,	—	—
,, 22,[3] . . .	2·00	3·90
,, 29, . . .	1·80	3·00
April 5, . . .	1·75	2·70
,, 12, . . .	0·90	1·70
,, 19, . . .	1·25	2·35
,, 26, . . .	1·35	2·35
May 3, . . .	1·85	2·80
,, 10, . . .	1·75	3·00
,, 17, . . .	1·70	2·90
,, 24, . . .	1·65	2·55
,, 31, . . .	1·25	2·00
June 7, . . .	1·80	2·20
,, 14, . . .	1·05	1·75
,, 21,[4]	—	—
,, 28,[5] . . .	0·20	− 0·40
July 12,[6] . .	− 0·70	− 1·50
,, 19, . .	− 1·00	− 1·50
,, 26, . . .	− 0·40	− 0·70
August 2, . . .	1·20	1·50
,, 9, . . .	1·35	1·80
,, 16, . . .	1·30	1·65
,, 23, . . .	1·10	1·50
,, 30, . . .	1·00	1·65

	Inches. A.	Inches. B.
Sept. 6, . . .	0·70	1·10
,, 13, . . .	0·20	1·40
,, 20, . . .	1·20	1·50
,, 27, . . .	0·80	1·20
October 4, . . .	1·10	1·40
,, 11, . . .	1·30	1·70
,, 18, . . .	1·70	2·10
,, 25, . . .	1·10	1·60
Novemb. 1, . . .	1·40	1·70
,, 8, . . .	1·70	2·00
,, 15, . . .	1·75	2·30
,, 22, . . .	1·55	2·00
,, 29,	—	—
Decemb. 6, . . .	1·60	2·00
,, 13, . . .	1·50	2·00
,, 20, . . .	1·75	2·35
,, 27,	—	—
January 3, 1864,	—	—
,, 10,[7] . . .	3·86	5·68
,, 17, . . .	1·87	2·16
,, 24, . . .	1·65	2·35
,, 31, . . .	1·50	2·30
Feb. 7, . . .	1·25	2·00
,, 14, . . .	1·75	2·35
,, 21, . . .	1·15	1·70
,, 28, . . .	1·60	2·40
March 6, . . .	1·25	2·00
,, 13, . . .	1·65	2·50
,, 20, . . .	1·35	2·15
,, 27, . . .	1·80	2·60
April 3, . . .	1·70	2·50
,, 10, . . .	1·20	2·00
,, 17, . . .	0·90	1·50
,, 24, . . .	1·50	2·25

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[1] Level of water in tub half an inch above that in the glass.

[2] Water in tub again a little above that in glass.

[3] For two weeks.

[4] Not recorded, but very small.

[5] The first instance of an excess of rain.

[6] For two weeks, during which time a net covered both glasses. I had placed it there fearing the birds had been in the habit of drinking the water; but I removed the net to-day, because, on consideration, I thought it would have a tendency to conduct the drops of rain away from the glass. I have never seen any birds on the roof, and I think they could not reach the water in the glasses, no matter how thirsty they might be.

[7] For three weeks.

		Inches. *A.*	Inches. *B.*
MAY	1,	1·60	2·45
"	8,[1]	1 45	2·20
"	15,[2] [3]	0·25	0·85
"	22,	0·75	1·45
"	29,	1·30	1·95
JUNE	5,	—	—
"	12,[4]	2·10	3·25
"	19,	0·55	1·20
"	26,	0·90	1·45
JULY	3,	0·80	1·35
"	10,	1·10	1·70
"	17,	1·25	1·85
"	24,	1·05	1·70
"	31,	—	—
AUGUST	7,[5]	1·10	2·20
"	14,	0·85	1·35
"	21,	1·25	1·75
"	28,	1·05	1·60

		Inches. *A.*	Inches. *B.*
SEPT.	4,	1·10	1·65
"	11,	1·40	2·15
"	18,	0·80	1·30
"	25,	1·40	2·05
OCTOBER	2,	1·30	1·90
"	9,	1·45	2·05
"	16,	1·45	2·10
"	23,	1·60	2·25
"	30,	—	—
NOV.	6,[6]	2·70	3·75
"	13,	—	—
"	20,[7]	2·50	3·60
"	27,	1·70	2·36
DEC.	4,	1·00	1·90
"	11,	1·02	1·63
"	18,	1·60	2·50
"	25,	1·50	2·25

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[1] Taken 3 hours late.

[2] Great mountain torrent at Sandy Bay on the 11th.

[3] Cleaned out the glasses.

[4] For two weeks.

[5] For two weeks.

[6] For two weeks.

[7] For two weeks.

PART II.—MAJOR PHILLIPPS'S OBSERVATIONS ON THE RAIN-FALL AT ST. HELENA.

Height above the Sea, 700 Feet.

LADDER HILL, ST. HELENA.

Year.	Date.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1861.	1st, . . .	No Observations taken.	Ditto.	No Observations taken.	0·02	..	No Observations taken.	..	0·11	..	0·01	0·02	..
	2nd, . . .				..	..		..	0·08	..	..	0·01	0·01
	3rd, . . .				..	0·33		0·11	0·05	..	0·01	0·01	..
	4th, . . .				..	0·04		..	0·04	..	..	0·01	..
	5th, . . .				..	..		0·02	0·02	..	..	0·02	..
	6th, . . .				0·45	..		0·06	0·30	0·01	..	0·01	..
	7th, . . .				0·19	..		0·47	0·00	..	..	0·03	0·01
	8th, . . .				0·16	..		0·11	..	..	..	0·04	0·02
	9th, . . .				0·08	0·02		0·16	0·01	0·01	0·01	..	0·19
	10th, . . .				0·07	0·04		0·13	0·27	..	0·04	..	0·03
	11th, . . .				..	0·04		0·02	0·01	0·05	0·01	..	0·01
	12th, . . .				0·02	0·61		0·02	0·06	..	..	..	0·03
	13th, . . .				0·13	0·12		..	0·05	0·06	..	..	0·03
	14th, . . .				0·07	No Observations taken.		..	0·54	0·01	..	..	..
	15th, . . .				..			..	0·28	..	..	0·05	0·08
	16th, . . .				..			..	0·05	..	..	..	0·01
	17th, . . .			0·30	..			..	0·01	0·02	..	..	0·01
	18th, . . .			0·14	..			..	0·03	0·06	0·01	0·02	..
	19th, . . .			0·01	0·03			..	..	0·01	..	0·01	..
	20th, . . .			..	0·05			0·10	..	0·05	0·01	0·03	..
	21st, . . .			0·07	0·05			0·01	..	0·10	0·02	0·02	..
	22nd, . . .			0·05	..			0·07	..	0·08	0·02	0·01	..
	23rd, . . .			0·05	..			0·02	..	0·08	0·01	0·01	..
	24th, . . .			0·20	0·08			0·11	0·17	0·03	0·05	0·02	..
	25th, . . .			0·18	..			0·35	0·02	0·01	..	..	..
	26th, . . .			0·02	..			0·04	0·01	..	..	..	0·01
	27th, . . .			..	0·03			0·20	..	..	..	..	..
	28th, . . .			0·06	..			0·15	..	..	..	0·02	0·08
	29th, . . .			..	..			0·04	..	0·06	..	0·01	0·03
	30th, . . .			..	..			0·06	..	0·01	0·01	..	0·02
	31st, . . .			..	..			0·08	..	..	0·04	..	0·03

The Rain Gauge used was a zinc funnel, five inches diameter, made by Messrs. Negretti and Zambra, placed in a bottle buried to the neck in earth. Rain-fall was measured in a glass having one inch of rain divided into 100 parts. Observations were taken at 9 A. M. each day.

E *showing the Rain-Fall at Ladder Hill, St. Helena.*
Height above the Sea, 700 *Feet.*

LADDER HILL, ST. HELENA.

186[illegible].

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
t,	..	·01	..	..	·03	·01	·03	·18	·01	..	..	..
2nd,	..	·04	·02	..	·01	..	..	·25	..	·02	..	..
3rd,	..	·20	·11	..	..	..	·09	·09	..	·02	·02	..
4th,	.	·03	·05	..	..	..	·16	·02	..	..	..	·01
	5	·14	·01	..	..	·02	·09	..	..	..	..	·02
	4	·03	..	..	..	..	·14	..	·01	·03	..	·07
th.	2	·01	·30	..	..	..	·13	·24	..	·05	..	·07
	·03	..	·20	·06	..	..	·03	·07	..	·12	..	·02
	·05	..	·02	·01	..	..	..	·10	..	·01	..	·01
	·04	..	·01	..	..	..	·23	·05	..	·01	..	..
	·04	·01	..	·03	..	·05	·37	·02	..	·10	..	..
,	..	..	·01	·13	..	·07	·04	..	..	·02	·05	..
,	..	·05	·05	·09	..	..	·03	..	..	..	·01	..
h,	..	·22	·02	·01	..	·28	..	..	·06	·02	..	..
15th,	·04	·07	·01	·03	..	·09	·47	..	·03	·17	·13	..
16th,	·03	·01	·02	·04	..	·38	·27	·04	·01	·06	·07	..
17th,	..	·01	·13	·03	..	·71	·10	·09	..	·05	·06	..
18th,	·02	..	·17	·32	·10	·27	·02	·05	·05	·07	·06	..
19th,	·01	..	·20	·31	·21	·11	·07	·01	·06	·14	·05	..
20th,	·06	..	·02	·36	·16	·10	·23	..	·04	·01	·02	..
21st,	·05	·01	..	·01	..	·13	·12	..	·07	..	·03	..
22nd,	..	..	..	..	·02	·10	·07	·01	·04	..	·01	..
23rd,	·05	·02	..	..	·11	·01	·18	..	·03	..	..	·07
24th,	·05	·04	..	·03	·05	·21	·03	..	·01	..	·02	·08
25th,	·16	·06	..	·03	..	·12	..	..	·01	..	·02	·05
26th,	·01	·08	..	·04	·01	·10	..	..	·10	..	·02	·02
27th,	·17	·04	..	..	..	·55	..	·03	·01	..	·11	·01
28th,	·69	..	..	..	·05	·03	·05	·01	..	..	·15	·01
29th,	·72	..	..	..	·10	·08	·04	·03	·06	..	·02	·08
30th,	·16	..	..	·08	·08	·06	·05	·08	·01	..	..	·01
31st,	·03	..	·03	..	·06	..	·21	·06	..	..	..	·12

The Rain Gauge used was a zinc funnel, of five inches diameter, made by Messrs. Negretti and Zambra, placed in a bottle buried to the neck in earth. Rain-fall was measured in a glass having one inch of rain divided into 100 parts. Observations were taken at 9 A. M. each day.

SUMMARY.

Month.	Days on which Rain fell.	Total Rain-fall in Inches.
January, ...	22	2·62
February, ...	19	1·08
March, ...	18	1·38
April, ...	17	1·61
May, ...	13	0·99
June, ...	21	3·48
July, ...	25	3·25
August, ...	19	1·43
September, ...	17	0·61
October, ...	16	0·90
November, ...	17	0·85
December, ...	15	0·65
Total during 1862, . .	**219**	**18·85**

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
JANUARY, 1863.	1	0·02	Recorded by Major PHILLIPPS, R. A.
	2	..	
	3	..	
	4	0·05	
	5	..	
	6	0·02	
	7	..	
	8	0·01	
	9	..	
	10	..	
	11	0·04	
	12	0·03	
	13	0·02	
	14	..	
	15	0·07	
	16	0·09	
	17	0·03	
	18	0·04	
	19	0·01	
	20	..	
	21	0·06	
	22	0·01	
	23	0·03	
	24	0·04	
	25	0·01	
	26	..	
	27	..	
	28	..	
	29	0.05	
	30	0·04	
	31	..	

Total Rain-fall, . . **0·67** of a inch.

Month.	Date.	Rain.	Remarks.
FEBRUARY, 1863.	1	0·11	Recorded by Major PHILLIPPS, R. A.
	2	0·04	
	3	..	
	4	..	
	5	0·10	
	6	0·03	
	7	0·04	
	8	0·06	
	9	0·08	
	10	0·46	
	11	0·05	
	12	0·08	
	13	0·29	
	14	0·12	
	15	0·16	
	16	0·09	
	17	0·15	
	18	0·15	
	19	..	
	20	..	
	21	0·01	
	22	..	
	23	..	
	24	0 12	
	25	0·15	
	26	0·24	
	27	0·02	
	28	0·01	

Total Rain-fall, . . . **2·56** inches.

LADDER-HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
MARCH, 1863.	1	0·15	Recorded by Lieut. F. T. Lloyd, R. A.
	2	0·17	
	3	0·06	
	4	0·01	
	5	0·04	
	6	0·05	
	7	0·34	
	8	0·05	
	9	0·09	
	10	0·51	
	11	0·40	
	12	0·49	
	13	0·29	
	14	0·10	
	15	0·02	
	16	0·01	
	17	..	
	18	0·10	
	19	0·01	
	20	0·13	
	21	0·03	
	22	..	
	23	..	
	24	0·04	
	25	..	
	26	0·01	
	27	..	
	28	0·09	
	29	0·04	
	30	..	
	31	0·01	

Total Rain-fall, . . . 3·24 inches.

Month.	Date.	Rain.	Remarks.
APRIL, 1863.	1	..	Recorded by Ensign G. H. Evans, St. Helena Regiment.
	2	0·01	
	3	..	
	4	..	
	5	0·03	
	6	0·25	
	7	0·21	
	8	0·19	
	9	0·01	
	10	0·02	
	11	0·15	
	12	..	
	13	..	
	14	..	
	15	..	
	16	0·11	
	17	0·59	
	18	0·02	
	19	..	
	20	0·03	
	21	0·05	
	22	0·03	
	23	0·02	
	24	..	
	25	0·04	
	26	..	
	27	0·03	
	28	..	
	29	..	
	30	..	

Total Rain-fall, . . . 1·79 inches.

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
MAY, 1868.	1	. .	Recorded by Ensign G. H. Evans, St. H. Regt.
	2	. .	
	3	. .	
	4	. .	
	5	. .	
	6	. .	
	7	. .	
	8	. .	
	9	. .	
	10	. .	
	11	0·01	
	12	. .	
	13	. .	
	14	. .	
	15	. .	
	16	. .	
	17	. .	
	18	. .	
	19	. .	
	20	. .	
	21	. .	
	22	. .	
	23	. .	
	24	. .	
	25	. .	
	26	0·04	
	27	. .	
	28	0·01	
	29	. .	
	30	0·25	
	31	0·08	

Total Rain-fall, . . 0·39 of an inch.

Month.	Date.	Rain.	Remarks.
JUNE, 1868.	1	0·07	Recorded by Lieutenant John Haughton, R. A.
	2	0·01	
	3	0·01	
	4	. .	
	5	. .	
	6	. .	
	7	. .	
	8	0·05	
	9	0·05	
	10	0·04	
	11	. .	
	12	. .	
	13	. .	
	14	. .	
	15	. .	
	16	0·66	
	17	0·12	
	18	0·14	
	19	0·25	
	20	0·30	
	21	0·69	
	22	. .	
	23	0 02	
	24	0·04	
	25	. .	
	26	0·01	
	27	1·02	
	28	0·20	
	29	. .	
	30	0·15	

Total Rain-fall, . . . 3·83 inches.

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
JULY, 1863.	1	0·32	Recorded by Major Phillipps, R. A.
	2	. .	
	3	0·16	
	4	0·09	
	5	0·16	
	6	0·22	
	7	0·10	
	8	0·32	
	9	0·41	
	10	0·16	
	11	0·04	Recorded by Lieutenant John Haughton, R. A.
	12	. .	
	13	0·03	
	14	0·01	
	15	0·05	
	16	No observation.	
	17	0·10	
	18	0·12	
	19	0·17	
	20	0·02	
	21	0·15	
	22	. .	
	23	0·19	
	24	0·09	
	25	0·32	
	26	0·09	
	27	0·08	
	28	0·12	
	29	No observation.	
	30	. .	
	31	. .	

Total Rain-fall, . . . **3·52** inches.

Observations.

Rain Gauge.—Negretti and Zambra's zinc funnel, five inches in diameter, placed in a bottle buried in the earth. The rain was measured in a glass, having one inch of rain divided into 100 parts.

Thermometer. — Maximum taken from a mercurial thermometer; minimum taken from a spirit thermometer: both placed in the shade, and as much as possible out of the wind.

The thermometers are self-registering.

Paul W. Phillipps,
Major, R. A.

Ladder Hill, St. Helena,
August 12, 1863.

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
AUGUST, 1863.	1	..	Recorded by Major PHILLIPPS, R. A.
	2	..	
	3	..	
	4	..	
	5	..	
	6	0·01	
	7	..	
	8	..	
	9	..	
	10	0·01	
	11	0·03	
	12	0·04	
	13	0·03	
	14	0·04	
	15	0·01	
	16	..	
	17	0·21	
	18	0·03	
	19	0·03	
	20	0·19	
	21	0·03	
	22	0·04	
	23	..	
	24	..	
	25	0·01	
	26	..	
	27	..	
	28	..	
	29	0·03	
	30	0·07	
	31	0·03	

Total Rain-fall, **0·84** of an inch.

Month.	Date.	Rain.	Remarks.
SEPTEMBER, 1863.	1	0·12	Recorded by Major PHILLIPPS, R. A.
	2	0·16	
	3	0 02	
	4	..	
	5	0·13	
	6	0·04	
	7	..	
	8	..	
	9	0·08	
	10	0·02	
	11	0·04	
	12	..	
	13	..	
	14	..	
	15	..	
	16	..	
	17	..	
	18	..	
	19	0·07	
	20	0·03	
	21	..	
	22	0·04	
	23	0·13	
	24	0·20	
	25	0·02	
	26	0·03	
	27	0·01	
	28	0·02	
	29	0·11	
	30	0·07	

Total Rain-fall, . . . **1·35** inches.

LADDER-HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.	Month.	Date.	Rain.	Remarks.
OCTOBER, 1863.	1	0·14	Recorded by Major Phillipps, R. A.	NOVEMBER, 1863.	1	0·01	Recorded by Major Phillipps, R. A.
	2	0·10			2	. .	
	3	0·07			3	0·01	
	4	0·06			4	. .	
	5	0·01			5	. .	
	6	0·11			6	. .	
	7	0 07			7	. .	
	8	0 01			8	. .	
	9	. .			9	. .	
	10	0·05			10	. .	
	11	0·01			11	0·02	
	12	. .			12	. .	
	13	. .			13	. .	
	14	0·03			14	. .	
	15	. .			15	. .	
	16	0·02			16	. .	
	17	0·08			17	0·02	
	18	0·10			18	. .	
	19	0·07			19	0·01	
	20	0·14			20	. .	
	21	0·03			21	. .	
	22	0·08			22	0·02	
	23	0·12			23	0·05	
	24	. .			24	0 02	
	25	. .			25	0·07	
	26	. .			26	0·03	
	27	. .			27	0·01	
	28	0·07			28	0·04	
	29	0·01			29	0·01	
	30	0·05			30	. .	
	31	0·06					

Total Rain-fall, . . . 1·44 inches.

Total Rain-fall, . . 0·32 of an inch.

LADDER-HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
DECEMBER, 1863.	1	0·03	Recorded by Major PHILLIPPS, R. A.
	2	0·09	
	3	. .	
	4	. .	
	5	0·02	
	6	. .	
	7	0·04	
	8	0·01	
	9	. .	
	10	. .	
	11	0·04	
	12	0·01	
	13	0·02	
	14	. .	
	15	. .	
	16	0·04	
	17	. .	
	18	. .	
	19	. .	
	20	. .	
	21	. .	
	22	. .	
	23	. .	
	24	. .	
	25	. .	
	26	0·06	
	27	0·04	
	28	0·02	
	29	0·04	
	30	0·10	
	31	. .	

Total Rain-fall . . 0·56 of an inch.

Month.	Date.	Rain.	Remarks.
JANUARY, 1864.	1	0·02	Recorded by Major PHILLIPPS, R. A.
	2	0·04	
	3	0·06	
	4	0·03	
	5	0·02	
	6	0·02	
	7	0·01	
	8	0·02	
	9	. .	
	10	0·01	
	11	0·02	
	12	. .	
	13	0·05	
	14	0·11	
	15	0·05	
	16	. .	
	17	0·05	
	18	0·03	
	19	. .	
	20	0·02	
	21	. .	
	22	. .	
	23	. .	
	24	. .	
	25	. .	
	26	0·02	
	27	0·01	
	28	0·09	
	29	0·06	
	30	0·09	
	31	0·06	

Total Rain-fall, . . 0·89 of an inch.

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
FEBRUARY, 1864.	1	0·02	Recorded by Major PHILLIPPS, R. A.
	2	0·01	
	3	0·01	
	4	0·13	
	5	0·18	
	6	0·03	
	7	..	
	8	0·01	
	9	..	
	10	0·02	
	11	0·01	
	12	0·03	
	13	0·06	
	14	0·02	
	15	0·03	
	16	0·01	
	17	0·03	
	18	0·12	
	19	0·04	
	20	0·14	
	21	..	
	22	..	
	23	0·04	
	24	0·08	
	25	0·17	
	26	0·04	
	27	0·01	
	28	0·08	
	29	0·10	

Total Rain-fall, . . . 1 42 inches.

Month.	Date.	Rain.	Remarks.
MARCH, 1864.	1	0·12	Recorded by Major PHILLIPPS, R. A.
	2	0·18	
	3	..	
	4	0·05	
	5	0·18	
	6	0·03	
	7	0·09	
	8	0·03	
	9	0·06	
	10	..	
	11	..	
	12	..	
	13	0·02	
	14	..	
	15	..	
	16	..	
	17	0·02	
	18	0·07	
	19	0·17	
	20	0·01	
	21	0·04	
	22	..	
	23	..	
	24	..	
	25	..	
	26	..	
	27	..	
	28	..	
	29	0·09	
	30	0·02	
	31	0·04	

Total Rain-fall, . . 1·28 inches.

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
APRIL, 1864.	1	0·02	Recorded by Major Phillipps, R. A.
	2	0·08	
	3	0·03	
	4	..	
	5	..	
	6	0·03	
	7	0·17	
	8	0·10	
	9	0·23	
	10	0·18	
	11	0·22	
	12	0·14	
	13	0·06	
	14	0·04	
	15	0·13	
	16	0·06	
	17	0·08	
	18	0·04	
	19	0·08	
	20	0·03	
	21	..	
	22	..	
	23	..	
	24	0·02	
	25	..	
	26	..	
	27	0·02	
	28	..	
	29	0·01	
	30	..	
Total Rain-fall, . . 1·77 inches.			

Month.	Date.	Rain.	Remarks.
MAY, 1864.	1	..	Recorded by Major Phillipps, R. A.
	2	..	
	3	..	
	4	..	
	5	..	
	6	..	
	7	0·12	
	8	0·26	
	9	0·29	
	10	0·17	
	11	0·21	
	12	..	
	13	..	
	14	0·28	
	15	0·17	
	16	..	
	17	..	
	18	0·16	
	19	0·22	
	20	0·37	
	21	0·11	
	22	..	
	23	..	
	24	..	
	25	..	
	26	..	
	27	..	
	28	..	
	29	..	
	30	0·03	
	31	..	
Total Rain-fall, . . 2·39 inches.			

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
JUNE, 1864.	1	0·08	Recorded by Major PHILLIPPS, R. A.
	2	0·06	
	3	0·32	
	4	0·20	
	5	0·03	
	6	. .	
	7	. .	
	8	. .	
	9	. .	
	10	. .	
	11	. .	
	12	. .	
	13	. .	
	14	0·31	
	15	0·37	
	16	0·14	
	17	0·19	
	18	0·16	
	19	0·18	
	20	0·14	
	21	. .	
	22	. .	
	23	0·08	
	24	0·15	
	25	0·09	
	26	. .	
	27	0·15	
	28	0·26	
	29	0·04	
	30	. .	

Total Rain-fall, . . 2·90 inches.

Month.	Date.	Rain.	Remarks.
JULY, 1864.	1	. .	Recorded by Major PHILLIPPS, R. A.
	2	. .	
	3	. .	
	4	. .	
	5	0·10	
	6	. .	
	7	. .	
	8	0·05	
	9	. .	
	10	. .	
	11	. .	
	12	0·02	
	13	. .	
	14	. .	
	15	. .	
	16	0·14	
	17	0·06	
	18	. .	
	19	0·09	
	20	0·08	
	21	0·03	
	22	0·09	
	23	0·04	
	24	0·05	
	25	0·11	
	26	0·30	
	27	0·29	
	28	0·11	
	29	0·02	
	30	. .	
	31	. .	

Total Rain-fall, . . 1·58 inches.

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.
AUGUST, 1864.	1	0·06	Recorded by Major PHILLIPPS, R. A.
	2	0·03	
	3	0·02	
	4	0·05	
	5	0·44	
	6	0·42	
	7	0·15	
	8	0·27	
	9	..	
	10	..	
	11	..	
	12	..	
	13	0·06	
	14	..	
	15	..	
	16	0·03	
	17	0·12	
	18	..	
	19	..	
	20	..	
	21	..	
	22	0·12	
	23	0·06	
	24	0·04	
	25	..	
	26	0·03	
	27	..	
	28	..	
	29	..	
	30	0·02	
	31	..	

Total Rain-fall, . . **1·92** inches.

Month.	Date.	Rain.	Remarks.
SEPTEMBER, 1864.	1	..	Recorded by Major PHILLIPPS, R. A.
	2	..	
	3	0·05	
	4	..	
	5	0·02	
	6	..	
	7	0·04	
	8	0·08	
	9	0·10	
	10	0·04	
	11	0·05	
	12	0·15	
	13	0·21	
	14	0·18	
	15	0·07	
	16	0·08	
	17	0·04	
	18	..	
	19	..	
	20	0·02	
	21	..	
	22	..	
	23	0·03	
	24	..	
	25	0·06	
	26	0·05	
	27	..	
	28	..	
	29	..	
	30	..	

Total Rain-fall, . . **1·27** inches.

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Remarks.	Month.	Date.	Rain.	Remarks.
OCTOBER, 1864.	1	. .	Recorded by Major PHILLIPPS, R A.	NOVEMBER, 1864.	1	. .	Recorded by Major PHILLIPPS, R. A.
	2				2	. .	
	3	. .			3	. .	
	4	. .			4	. .	
	5	. .			5	. .	
	6	. .			6	0·08	
	7	. .			7	. .	
	8	. .			8	. .	
	9	. .			9	. .	
	10	. .			10	0·02	
	11	. .			11	0·03	
	12	. .			12	0·04	
	13	. .			13	. .	
	14	0·06			14	. .	
	15	0·05			15	. .	
	16	0·08			16	. .	
	17	. .			17	. .	
	18	. .			18	. .	
	19	0·05			19	0·02	
	20	0·02			20	0·02	
	21	0·04			21	. .	
	22	0·02			22	. .	
	23	0·02			23	. .	
	24	0·03			24	0·02	
	25	. .			25	. .	
	26	. .			26	. .	
	27	. .			27	. .	
	28	. .			28	. .	
	29	0·02			29	0·05	
	30	. .			30	0·06	
	31	. .					
Total Rain-fall, . . 0·34 of an inch.				Total Rain-fall, . . 0·34 of an inch.			

LADDER HILL, ST. HELENA.

Month.	Date.	Rain.	Month.	Date.	Rain.	Remarks.
DECEMBER, 1864.	1	0·05	DECEMBER, 1864—*continued.*	17	. .	Recorded by Major PHILLIPPS, R. A.
	2	0·03		18	. .	
	3	0·06		19	. .	
	4	0·05		20	. .	
	5	0·15		21	. .	
	6	0 04		22	. .	
	7	. .		23	. .	
	8	0·05		24	0·02	
	9	0·10		25	. .	
	10	0·15		26	. .	
	11	. .		27	. .	
	12	0·04		28	0·02	
	13	0·03		29	0·03	
	14	. .		30	0·05	
	15	. .		31	. .	
	16	. .				

Total Rain-fall, . . . 0·87 of an inch.

In the following Table I have collected together, in the form of an abstract, the preceding Observations on Evaporation and Rain-fall, week by week.

The column marked *E*−*R* denotes Evaporation minus Rain-fall for each week, observed in the cylinder surrounded by water; the column *R* denotes the weekly Rain-fall; and the column *E* denotes the Evaporation, deduced from the preceding.

	Date.	*E*−*R*.	*R*.	*E*.
1862.	Aug. 10	1·00	0·48	1·48
	„ 17	1·50	0·15	1·65
	„ 24	1·00	0·07	1·07
	„ 81	1·20	0·21	1·41
	Sept. 7	1·50	0·02	1·52
	„ 14	1·80	0·06	1·86
	„ 21	1·50	0·26	1·76
	„ 28	1·10	0·20	1·30
	Oct. 5	1·60	0·11	1·71
	„ 12	1·60	0·34	1·94
	„ 19	1·40	0·51	1·91
	„ 26	1·60	0·01	1·61
	Nov. 2	1·60	0·00	1·60
	„ 9	1·35	0·02	1·37
	„ 16	2·10	0·26	[1·31]*
	„ 23		0·23	[1·28]
	Dec. 7	1·55	0·17	1·72
	„ 14	1·60	0·03	1·68
	„ 21	1·45	0·00	1·45
	„ 28	1·55	0·24	1·74
1863.	Jan. 4	1·55	0·08	1·63
	„ 11	1·65	0·07	1·72
	„ 18	1·10	0·28	1·38
	„ 25	1·30	0·16	1·46
	Feb. 1	1·55	0·20	1·75
	„ 8	1·40	0·27	1·67
	„ 15	0·90	1·24	2·14
	„ 22	1·40	0·40	1·80
	Mar. 1	1·40	0·69	2·09
	„ 8	1·00	0·72	1·72
	„ 15	2·00	1·90	[2·90]
	„ 22		0·28	[1·28]
	„ 29	1·80	0·18	1·98
1868.	April 5	1·75	0·05	1·80
	„ 12	0·90	0·83	1·73
	„ 19	1·25	0·72	1·97
	„ 26	1·35	0·17	1·52
	May 8	1·85	0·03	1·88
	„ 10	1·75	0·00	1·75
	„ 17	1·70	0·01	1·71
	„ 24	1·65	0·00	1·65
	„ 81	1·25	0·38	1·63
	June 7	1·30	0·09	1·39
	„ 14	1·05	0·14	1·19
	„ 21	0·00	2·16	2·16
	„ 28	−0·20	1·29	1·09
	July 5	0·70	0·88	[1·23]
	„ 12		1·25	[1·60]
	„ 19	1·00	0·48	1·48
	„ 26	0·40	0·86	1·26
	Aug. 2	1·20	0·20	1·40
	„ 9	1·35	0·01	1·36
	„ 16	1·30	0·16	1·46
	„ 23	1·10	0·53	1·63
	„ 30	1·00	0·11	1·11
	Sept. 6	0·70	0·50	1·20
	„ 13	1·20	0·14	1·34
	„ 20	1·20	0·10	1·30
	„ 27	0·80	0·43	1·23
	Oct. 4	1·10	0·57	1·67
	„ 11	1·30	0·26	1·56
	„ 18	1·70	0·18	1·88
	„ 25	1·10	0·44	1·54
	Nov. 1	1·40	0·20	1·60
	„ 8	1·70	0·01	1·71
	„ 15	1·75	0·02	1·77

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* When two or three weeks are recorded together, the means are used, and such results are entered between brackets [ ].

	Date.	E - R.	R.	E.
1863.	Nov. 22	1·55	0·05	1·60[*]
	„ 29	—	0·23	[1·67]
	Dec. 6	1·60	0·14	1·74
	„ 13	1·50	0·12	1·62
	„ 20	1·75	0·04	1·79
	„ 27	3·86	0·10	[1·39]
1864.	Jan. 3		0·28	[1·56]
	„ 10		0·11	[1·40]
	„ 17	1·37	0·28	1·65
	„ 24	1·65	0·05	1·83
	„ 31	1·50	0·37	1·63
	Feb. 7	1·25	0·38	1·90
	„ 14	1·75	0·15	1·52
	„ 21	1·15	0·37	2·02
	„ 28	1·60	0·42	1·91
	Mar. 6	1·25	0·66	1·85
	„ 13	1·65	0·20	1·62
	„ 20	1·35	0·27	1·84
	„ 27	1·80	0·04	1·98
	April 3	1·70	0·28	1·91
	„ 10	1·20	0·71	1·66
	„ 17	0·90	0·76	1·62
	„ 24	1·50	0·12	1·63
	May 1	1·60	0·03	1·83
	„ 8	1·45	0·38	1·37
	„ 15	0·25	1·12	1·61
	„ 22	0·75	0·86	1·30
	„ 29	1·30	0·00	[1·79]
	June 5	2·10	0·00	[1·05]
	„ 12			
1864.	June 19	0·55	1·35	1·90
	„ 26	0·90	0·41	1·31
	July 3	0·80	0·45	1·25
	„ 10	1·10	0·15	1·25
	„ 17	1·25	0·22	1·47
	„ 24	1·05	0·38	1·43
	„ 31	1·10	0·83	[1·38]
	Aug. 7		1·17	[1·72]
	„ 14	0·85	0·33	1·18
	„ 21	1·25	0·15	1·40
	„ 28	1·05	0·25	1·30
	Sept. 4	1·10	0·07	1·17
	„ 11	1·40	0·33	1·73
	„ 18	0·80	0·73	1·53
	„ 25	1·40	0·11	1·51
	Oct. 2	1·30	0·05	1·35
	„ 9	1·45	0·00	1·45
	„ 16	1·45	0·14	1·59
	„ 23	1·60	0·15	1·75
	„ 30	2·70	0·05	[1·40]
	Nov. 6		0·08	[1·43]
	„ 13	2·50	0·09	[1·34]
	„ 20		0·04	[1·29]
	„ 27	1·70	0·02	1·72
	Dec. 4	1·00	0·30	1·30
	„ 11	1·02	0·49	1·51
	„ 18	1·60	0·07	1·67
	„ 25	1·50	0·02	1·52

If we combine the preceding results into periods of four weeks, commencing at winter solstice (summer in Southern hemisphere), we find the following Table, containing the thirteen lunar months of each year:—

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[*] The entries in brackets [ ] are deduced from those before and after them, or are means, when several weeks are recorded together.

TABLE *showing Evaporation for Periods of Four Weeks.*

Lunar Month.	Commencing December 22, 1862.	Commencing December 21, 1863.	Commencing December 20, 1864.	Mean.
	Inches.	Inches.	Inches.	Inches.
1	..	6·47	6·00	6·23
2	..	7·02	7·06	7·04
3	..	8·51	7·30	7·90
4	..	6·79	7·35	7·07
5	..	7·12	6·74	6·93
6	..	6·38	6·07	6·22
7	..	5·67	5·51	5·59
8	..	5·74	5·53	5·63
9	..	5·56	5·60	5·58
10	6·55	5·07	5·94	5·85
11	6·86	6·65	6·14	6·55
12	5·89	6·68	5·46	6·01
13	6·13	6·82	6·20	6·38
Total, . .		84·48	80·90	82·98

The last column of this Table is shown graphically in Plate I., and proves that the maximum and minimum of Evaporation follow the solstice by intervals different in summer and winter; the maximum occurring three months after, or nearly at the time of the equinox, and the minimum occurring one month and a half after its own solstice. This result differs from that formerly found for Dublin, where the maximum and minimum of Evaporation coincide very nearly with the times of the solstices themselves.

This difference is produced by causes not difficult of detection.

MONDAY, NOVEMBER 14, 1864.

The Very Rev. Charles Graves, D. D., President, in the Chair.

George V. Du Noyer, M. R. I. A., R. G. S. I., presented to the Library of the Royal Irish Academy, 99 Drawings from Original Sketches of Antiquities, in the counties of Westmeath, Longford, Meath, and King's County, to form Vol. VI. of similar donations; of these the following is the Catalogue:—

No. 1. Doorway of the church erected by St. Fechin at Fore, county of Westmeath; interior view. St. Fechin died A. D. 664.

No. 2. East window in the chancel of St. Fechin's church at Fore, showing thirteenth and probably sixteenth century work.

No. 3. Plan of the same church, showing the modern chancel, the date of which may be the thirteenth century, though modified in the sixteenth century, as is evident from the reconstruction of the east window.

No. 4. Proposed main doorway to the chapel of the Abbey of Fore. It would appear that this doorway, which is constructed in the west wall of a massive square tower placed at the west end of the chancel, was never completed, probably owing to some change of design in the construction of the abbey. There is no trace of its exterior semicircular arch in the interior portion of the doorway, while the simple roll-moulding which surrounds the doorway is left unfinished in the arch. The form of the doorway and that of the moulding is clearly of the thirteenth century.

No. 5. Capitals of cloister columns from the abbey at Fore. The style of the mouldings and the presence of a slender rib in the lower hollowed portion of the capital are all characteristic of the early English style, or that prevalent in the thirteenth century.

No. 6. Intercolumnation of some of the cloister arches from the abbey at Fore.

No. 7. View of the west gate of Fore, looking eastward.

No. 8. View of the same from the opposite direction.

No. 9. View of the east gate at Fore.

No. 10. Old font, built into the exterior of the wall of the Roman Catholic chapel at Fore.

No. 11. Monumental cross from the graveyard of St. Mary's church at Fore.

No. 12. Heraldic carving from a stone which appears to have formed the springing of one of the cloister arches at Fore Abbey; but now used as a headstone in the graveyard of St. Fechin's church. The device is a kite-shaped shield, on which is carved, in relief, two human arms, crossed, coupé at the shoulder, and clothed with a short "manche," which descends from the elbows; the right hand grasps the handle of a large cross-hilted dagger, the point of which extends beyond the top of the shield, and on it is impaled a human head, of which the features are defaced; resting on the shield, and beneath the left side of the head, is an ornament like the rowel of a spur.

No. 13. View of the east window of the Anchorites' church at Fore.* This building stands on the slope of the hill, just above the ancient church of St. Fechin, and its erection would date at about the early part of the sixteenth century; it consists of a massive, low, square tower, having a small projection in its north-west angle to admit of circular stairs, which led from the nave of the church, or basement floor of the tower, to the room over the arch, which was capable of being used as a dwelling, and was provided with a fireplace in the south wall. On the exterior of the north wall of the church is a small stone tablet, bearing the following inscription, in raised Roman capitals:—

> "THE RIGHT HONORABLE RICHARD NUGENT EARLE OF WESTMEATHE AT HIS OWN EXPENCES REBUILDED THIS CHAPLE AND CASTLE FOR THE BURYING PLACE AND PIOUS USE OF HIMSELF AND HIS SUCCESSORS ANNO DOMINI 1680."

Above this, and carved in high relief, is an earl's coronet, resting on a winged griffin.

No. 14. Plan of the Anchorites' church at Fore, showing the position of the fireplace in the room above the arched chancel. It would appear that subsequent to the building of the tower the circular stairs were blocked up, and a doorway opened into this room in the wall over the chancel arch, access to which must then have been by a ladder from the nave of the church.

No. 15. Doorway of the very ancient church at Agharra,† in the county of Longford, near the village of Legan. This doorway is flat-headed, and quite Cyclopean in its character, being as beautifully and massively constructed as the doorways of this class which we find at Glendalough. The lintel measures six feet six inches in length, and some of the adjoining stones measure seven feet six inches in length. I am not aware that this very ancient church has ever been described by any antiquary.

No. 16. View of the central gable of the old church of Agharra, which was originally the east gable of the building, showing the insertion of a doorway and a window loop in it, in order to adapt the western or ancient portion of the church to the purpose of a dwelling-house; by this modification the chancel was available as a chapel for

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[NOTES BY THE REV. DR. REEVES.]

* The Anker House at Fore.

See, for description, Vallancey's "Collectanea," vol. i., p. 63. *See* Harris' "Ware," vol. ii., p. 135.

† Agharra I take to be a phonetic form of *Echaradh*, which is thus mentioned in the "Calendar of Marian Gorman," and the "Martyrology of Donegal," at April 11:—"Aedh of Echaradh" (p. 101).

the neighbouring castle of Ardanragh—a building probably of the sixteenth century.

No. 17. East window of the same old church, showing the stone socket for the internal shutter to swing on.

No. 18. Small window loop in the south wall of the chancel of the same old church, the date of which is coeval with this portion of the building, and is probably of the sixteenth century.

No. 19. Plan of the same old church, showing the modern chancel, and the modifications of the original east gable. The walls of the ancient church are without foundations, but they rest on a rough basement or plinth of large flags. This peculiar mode of construction has been followed by the builders of the chancel, either from veneration or for convenience. A large flat-headed doorway in the north wall of the chancel allowed access to this portion of the building, while a similar doorway in the central gable allowed of communication with the ancient or western part of the building.

No. 20. Near Foxhall, county of Longford, and in the parish of Rathreagh (Ordnance Survey, Sheet 20), there is an ancient mound, in the centre of which stands what is called "The Caldragh Stone," of which this is a sketch. The monument in question, which is undoubtedly of great antiquity, consists of a block of stone, five feet in height, ten inches in breadth, flat at one side, and rounded on the other, and standing in a flat circular plinth; its apex, for something more than one foot, is fined off, and narrowed, or notched. This monument is evidently incomplete, and I feel disposed to believe that the shaft was intended to receive a cruciform head of wood, which rested on the notch at the top.

No. 21. Close to this small pillar is a flagstone, bearing the ornament here sketched; it consists of two circles, connected by a narrow band, the central portion of the former being ornamented by a Greek cross. The stone is broken in the middle, and I have no doubt but that when perfect there were three such circles engraved on it. This form of ornament, without the cross, is found on monuments of undoubted Pagan age in Ireland. *Vide* Vol. I., No. 14, of my "Antiquarian Sketches," where I have figured a slab of stone from the graveyard of Tully, in the county of Dublin, in which we find this triple circle connected by narrow bands, and which has been recognised as pre-Christian.

No. 22. View of the west gable of the old church at Feohran,* county of Westmeath, showing the ancient masonry at the base of the wall, with the comparatively modern flat belfry, pierced for three bells, above it.

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* *Foyran*, a parish in the extreme north of the county of Westmeath.

The Ordnance Survey (Westmeath, Sheet 1) marks "Church in Ruins, Graveyard," and "Bishop Hugh's Well (Tobar Aidain)."

The name of the church is written in Irish *Foibren* and *Faiobhran*.

The patron saint is thus commemorated, at Nov. 1, in the "Calendar of Marian Gorman" and the "Martyrology of Donegal":—"Aedh son of Roi, of Foibren."

The place is also noticed in the "Four Masters," at the year 751:—"Euchaidh son of Conall Meann, abbot of Faoibhran, died."

No. 23. View of the interior of the same church, which is said to have been dedicated to St. Edan, as a well bearing his name is close at hand. To the right of the view, in the south wall of the nave, is a very ancient window; the chancel arch is completely gone; beyond this, to the left of the view, is a portion of the east gable, with a small partition taken off the width of the chancel, to allow of a narrow flight of stairs, which conducted to the room over the arch of the chancel.

No. 24. Exterior view of the ancient window in the south wall of the nave of the same church. This feature is exceedingly interesting, as it shows the method adopted of closing the window with an external wooden shutter, a portion of the stone surrounding the ope having been cut away to receive it. It appears to me that in this and similar examples we have the origin of the external mouldings, and subsequent decorations of all our windows. At first these necessary adjuncts to buildings of stone were merely loops; and as they were made wider in process of time, the benefit of light and air was often counterbalanced by cold and wet, and it became necessary to close them externally by a shutter. A deep notch was therefore cut all round them to receive this construction; and this notch, after the introduction of glass in our churches and castles, was retained as an ornamental feature, and enlarged, modified in shape, and decorated as taste and architectural skill suggested.

No. 25. Interior view of the foregoing window, which shows that though the ope is triangular-headed externally, it is semicircular within —a feature which, I believe, is novel in windows of this class.

No. 26. Specimen of the masonry at the base of the south wall of the same old church, the character of which is quite Cyclopean, and will bear comparison with that of the churches at Glendalough.

No. 27. Plan of Feohran church, showing the more modern chancel, and the unique construction of the stairs to the room over this portion of the building.

Another place of the same name is mentioned in the "Four Masters," at 811, and placed by them in Crich Graicrighe, corresponding to the modern baronies of Coolavin in Sligo, and Castlereagh in Roscommon, in his note on which place Dr. O'Donovan confounds the two together, although in his Index Locorum he correctly has—

"Faebhran, or Faobhran, Foyran, in the barony of Fore, county of Westmeath, abbot of, 751;" and "Foibhren, in Crich-Graicrighe, 811."

Tober Aedhain is a well of cyclopean construction, the masonry of which is now entirely defaced.

Aedhan is the diminutive of *Aedh*, the latter being the form in the Calendars; and this is preserved in the English equivalent given for Tobar Aedhain, in the Ordnance Map, "Bishop *Hugh's* Well."

Among the appropriations of the Abbey of Fore was the "Ecclesia S. Edani de Fayron." Archdall, "Monast. Hib.," p. 715.

In Bp. Anthony Dopping's "Register of Meath Diocese" (Marsh's Library), the parish is noticed thus:—"Favoran, *alias* Foyran, *alias* Finnah. The last form is now written Finnea, and is the name of a hamlet on the river which connects Lough Sheelin and Lough Kinale."

No. 28. East window of the abbey at Abbey Shrule, in the county of Longford. The masonry is exceedingly rude; and the design of the window, which is broad lancet, of two lights, is clearly late thirteenth century.

No. 29. Exterior view of the same window.

No. 30. Carved stone from the graveyard of the abbey church at Abbey Shrule. This relic is cruciform above, where it is ornamented by deeply cut lines, resembling a rude reaping-hook, with the handle upright. The shaft is decorated by a broad interlacing of four bands, extending down its entire length. This stone no doubt dates to a period long prior to the construction of the abbey adjoining, and may be a remnant of the original church, which rendered the locality sacred.

No. 31. Two views of the same stone.

No. 32. View of the square keep of the old castle of Newcastle, county of Westweath, near Castlepollard, showing the entrance gateway to the outworks.

No. 33. Plans of the same old castle, showing the construction of the basement floor, and that above it. There are small angular turrets at the northern and western angles of the tower, formed by the prolongation of the side walls, and the platform of the parapet is continued through them. From the fact of the window loops and doorway in the interior of this tower being narrowed at the head by projecting bevelled stones, on which the flat head of each opening rests, I feel disposed to regard this tower as the work of the fourteenth century, probably during the reign of Edward III.

No. 34. View of the tower of Coolamber Castle, county of Longford, showing the postern gate on its western side. The remaining portion of the castle must have resembled a substantial house, the walls of which were about five feet thick, and the basement formed by a series of arches. This castle was erected by some of the Nugents of the family of the Barons of Westmeath.

35. Plan of the same castle.

No. 36. Plan of the old church of Coolamber. In a small grove, on the north side of the old road which passes by the castle of Coolamber, and close to the castle, on the east, there is a mutilated cross, on which is the following inscription, in raised Roman capitals:—

> "I H S. Pray for the Souls of Thomas Nugent deced 12 ian 1688 and of Rose Tyrell his wife."

In the graveyard of Coolamber old church there is a tombstone of the family of Farrell, or Farrall, the earliest date on which is 1799. The crest is a greyhound courant, with an earl's coronet beneath; then there is a lion courant, though, according to another tombstone of the same family, this animal should be rampant; and below all is the following Irish motto, deeply cut in Roman letters:—"coo BREI BE DERB," which Mr. Hennessy translates, "the rushing or tearing hound."

No. 37. Tower of the old church of Moylagh, county of Westmeath, between Fore and Oldcastle.

No. 38. Plan of the tower of Moylagh old church, showing how carefully it was adapted to form a residence, as it contains a fireplace and necessarium, and recess for a bed. The window loops have seats at either side, and access to the body of the church was by a flight of steps in the north wall of the tower. Probable date, the fourteenth century.

No. 39. Plan of the outworks of Carlanstown Castle, county of Westmeath, the date of which may be the sixteenth century. The tower at the north-west angle is singular, as the following illustrations will explain:—

No. 40. Plans of the basement and two upper floors of the tower at the north-west angle of the outworks at Carlanstown Castle.

No. 41. Loops for musketry from the same tower.

No. 42. View of the tower of Clonarney old church, county of Westmeath.

No. 43. Interior view of the same tower, looking north, showing the window in the north wall, and the adjoining doorway to the necessarium. This tower was set apart for the residence of the ecclesiastic, as at Moylagh church.

No. 44. Plan of the tower of Clonarney old church.

No. 45. View of the tower of Kilpatrick old church, county of Westmeath.

No. 46. Plan of the same tower, showing the alterations in the basement of the east wall by which the choir arch was built up, and a fireplace constructed over its crown to heat the apartment just below the arch of the tower. I believe the date of this building to be the fourteenth century.

No. 47. Doorway of Tagshinod old church, county of Longford, restored from fragments lying about.

No. 48. East window of the same old church, showing the introduction of the triquatra ornament at the head of the opening below the drip moulding.

No. 49. Plan of the same old church, the date of which may be the sixteenth century. The east gable has been propped up by a very massive buttress, at a comparatively recent date.

No. 50. Plan of Lacken old church, county of Westmeath, showing the more modern chancel and choir arch, and the small circular stairs to the west of the doorway, which probably led to the gallery, which was supported on the corbels at the eastern end of the nave. I think it probable that this church may date to the fourteenth century, if not earlier.

No. 51. Interior view of the tower of Tristernagh old church, county of Westmeath, looking west, and showing the two doorways to the body of the building, one in the north, and the other in the south side wall. The doorway in the west wall of the tower leads to the upper floor of that building, which was set apart and adapted for the dwelling place of the ecclesiastic. The large opening over the arch supporting the east wall of the tower is on a level with the floor of this room, and I believe led to the space between the roof and the flat ceiling of the church.

No. 52. Plans of Tristernagh old church and tower; that of the upper floor of the latter shows the position of the fireplace and the necessarium; that portion of the west wall over the stairs, and the recess in the same wall, close to the south angle, have small spaces or turrets over them, marked by dotted lines on the plan.

No. 53. Plan of the old church at Lickblaw, near Castlepollard. This building, which consists of nave and chancel, having the doorway in the south wall, is not of older date than the fifteenth century.

No. 54. East window of the same church.

No. 55. Plan of Morning Castle, county of Longford. This building, which is a square tower of massive proportions, has been mutilated from time to time by the systematic removal of all the quoin stones to near the summit, and all the cut stones or casings of the doors and windows. So completely shaken is the whole tower by this spoliation, that I should not be surprised to hear of its fall in a short time, especially during weather which would be alternately wet and freezing.

No. 56. Plan of Skurlockstown Castle, county of Westmeath, near Collinstown.

No. 57. Plan of the old church of Moat Farrel, county of Longford. Near this ruin is the Moat of Farrel, on which once stood the castle residence of the O'Farrall or O'Farell family. There is a tradition preserved in connexion with this family and that of the O'Reillys and the Edgeworths, which may be worth preserving; I believe that it is founded on truth, and I know it is recognised as such by the family of the Edgeworths. Some time about the early part of the seventeenth century the Farralls and the O'Reillys owned large possessions on the eastern borders of the county of Longford; and as the country was in a very disturbed and unsettled state, the O'Farralls, trusting to what they believed their superior interest and power, devised a plan by which they might gain possession of the property of the neighbouring O'Reillys. On a stated occasion they invited the O'Reillys to a grand banquet at their castle of Moat Farrall, and arranged the meeting so that each O'Farrall had an O'Reilly placed by his side at the table. At a given signal, during the progress of the feast, the O'Farralls stabbed each his neighbour, so that not one of the O'Reillys left the banquet hall alive. Their success, however, was of short duration; for scarcely had they seized the territory of the O'Reillys when the English Government sent a strong force to punish such an atrocity, and the whole of the O'Farrall property was confiscated, and bestowed on an English officer, named Edgeworth, who was instrumental in the punishment of the guilty clan; and since that period the Edgeworths have retained possession of the estate.

No. 58. Plan of Mulehan's old church, county of Westmeath. This is the burying place of a branch of the Ogle family, and a tombstone there bears the following inscription:—

> "Nicholas and Abigail eldest son and daughter of Nicholas Ogle of Discertally gent. departed this life the eighth of July and the second of August the year above said (1682)."

No. 59. View of the "Minstrel's Grave," with Ross Castle and Crover Castle, with part of Lough Sheelin in the distance. I heard the following interesting legend relating to this locality, and I transcribe it from my notebook, as I jotted it down shortly after the recital:—"Can you tell me," said I to an old man, named O'Reilly, who resides on the spot, and who was passing along the byeroad leading to Ross Castle, "is that cross, standing on the summit of that mound of stones, placed in an ancient graveyard?" This I said, pointing to a small Calvary cross within half a mile of the castle. "No, Sir," said he, "it is not; no one was ever buried there but a gentleman and a lady, and they were lovers; we call it 'the Minstrel's Grave,' for he was a great musician, and she was the daughter of the Black Baron, who lived in Ross Castle—but I may as well tell you the whole story, and it is as true as life. It was in the time of the great trouble that the Black Baron Nugent lived in the Castle of Ross." "What trouble do you mean?" said I. "Sure, Sir, I mean the *great war* with the Catholics in the time of King Charles, and it lasted for ten years." "The rebellion of 1641?" "True enough, Sir," said he; "and the country had neither law or peace for all that time. We call it 'the great trouble.' Well, Sir, the Black Baron Nugent had a lovely daughter, and one day she went boating on Lough Sheelin; and when she passed near the castle of Crover, which you see standing on that little island in the lake, she heard some one playing music and singing most delightful. She ordered the boatman to land her at the castle. Now, she was a Protestant; and though the castle was owned by one of the O'Reillys, who was a Catholic, and though there was no good blood between him and the Black Baron, who was a tyrant of a man, as I'll tell you, yet the Lady Nugent was so kind and charitable, and so lovely, that all the country round was very fond of her, and would do anything to please her. Well, Sir, Lady Nugent looked into the castle, and there she saw an officer of the Catholics, who had been badly wounded, and who had fled to hide in the castle of Crover. He was lying on a sofa, very weak and pale, and playing on a harp and singing, so sad and sorrowful, that the Lady Nugent took great pity on him, and fell in love with him. His name was Irwin, and he was a colonel in the army of the great O'Neill, and had just come from abroad in Spain somewhere, to fight for the ould religion, and small blame to him. Well, Sir, Lady Nugent used to go every day to the castle to attend the wounded officer; but at last she found she could not be with him often enough when the summer had passed, as she had to cross a couple of miles of the lake, so she had a house built for him in the thick woods on the tained either from Cornwall, or from St. Michael's Mount, the ancient Cassiterides; and in mediæval times, chalices and patens, and other vessels and utensils connected with ecclesiastical uses, were often made of pure tin.

The following series of ancient Irish inscribed tomb slabs are from original sketches, taken at Clonmacnoise, in the King's County. In availing myself of the very limited time at my disposal for consulting such records as the "Annals of the Four Masters," I have, I believe, been able to identify some of these tomb slabs as being commemorative of people whose names are recorded in these "Annals."

No. 67. The first tomb slab is that which was close to St. Kieran's Well, half a mile distant from Clonmacnoise, on the Shannon Bridge road; it bears the name of Fechthach—Oꞃ ꝺo Ꝼechꞇhach. In the "Annals of the Four Masters" I find the death of Fachtna, lector of Clonmacnoise, recorded at the year 1024.

No. 68. Tomb slab, bearing the name Maelfinnia—Oꞃ ꝺo Maelꝼinnia. There is another tombstone, from Clonmacnoise, engraved by Dr. Petrie in his work on the "Round Towers," at p. 325, which bears the same name, and which he believes to be commemorative of the abbot of that name, son of Spellan, whose death is recorded in the "Chronicon Scotorum" at the year 992, and in the "Annals of the Four Masters" at 991. The ornamentation on the crosses of the two slabs is very different; in that before you, the arms of the cross end in stirrups, formed by the looping of the double line which makes the ornament. Are we to suppose that there were two abbots of Clonmacnoise of the same name? and if so, what date are we to assign to the tomb slab I have figured?

No. 69. Tombstone of Moelpatric—Oꞃ ꝺo Moelpaꞇꞃic.

No. 70. Tombstone of Daniel—Oꞃ ꝺo Ꝺaineill. I find that a *Daniel* was abbot of Glendalough, and died 866. Could he have been buried at Clonmacnoise, as being a more fashionable place of interment?

No. 71. Tombstone of Brigit—Oꞃ ꝺo bꞃiᵹiꞇ—apparently of equal antiquity with the former.

No. 72. Fragment of another ancient tombstone, the usual abbreviation, Oꞃ . ꝺo . (pray for), being surmounted by two small serpent-like animals.

No. 73. Tombstone bearing this inscription—Oꞃ aꞃ Ᵹillaᵹlaꞃain, A prayer on Gillaglarain. This slab was discovered by Mr. Molloy, the farmer who resides close to the ruins, only a few days before my visit to the place, on the 9th of April, 1863.

No. 74. Tombstone of Maelmhichil—Oꞃ ꝺo Maelmhichil.

No. 75. Tombstone of Mailcaeimghin (Mulkevin)—Oꞃ ꝺo Mailcem̄—with a contraction over the last letter. It is recorded in the "Annals of the Four Masters," that Maelcaeimhghin, son of Scannlan, abbot of Teach Mochua (Timahoe), died A. D. 928, and was buried at Clonmacnoise: this is doubtless his tombstone.

No. 76. Tombstone, with the inscription, Oꞃ ꝺo bonuiꞇ.

No. 77. Tombstone, with the inscription, Oꞃ ꝺo Maꞃꞇanan, or

Martanan (diminutive of Martin, "Little Martin"). An abbot of Clonmacnoise of this name is recorded to have died A. D. 867, and I see every reason to believe that this is his tombstone.

No. 78. Tombstone with this inscription—Oꞃ ꝺo Foᵹaꞃꞇach m̄ bꞃoénaín, or Fogarty, the son of Broenan.

No. 79. Tombstone with the name Cholumban—Oꞃ ꝺo Chollumban.

No. 80. Tombstone with the name Comgan—Oꞃ ꝺo Comᵹan. I find in the "Annals of the Four Masters" that a Comghan Foda was an archbishop at Clonmacnoise, and his death is recorded at the year 868. We must, I suppose, accept this as his tombstone.

No. 81. A mutilated tombstone, of which only the concluding part of the inscription remains; the letters are Elchlaꞃan.

No. 82. Tombstone with the inscription Oꞃ ꝺo Cellach. The "Annals of the Four Masters" record the death of a person of this name at the year 904; and doubtless this is his tombstone.

No. 83. Tombstone with the following inscription—Oꞇaꞃ huꝺꞃıne, i. e. Oꞃoıꞇ aꞃ huꝺꞃıne.

No. 84. Tombstone having the following inscription—Oꞃ aꞃ Maelquıaꞃaın, with a cross and smaller circle, of precisely the same type as that of St. Cronan's at Roscrea, and of which I have given an illustration in Vol. II., Nos. 55, 56, and 57, of my "Antiquarian Sketches."

No. 85. A tomb slab, of apparently similar age, from the similarity of the form of cross engraved on it, and bearing simply the name Ronaın, i. e. (stone) of Ronan. I find that there were two abbots of Clonmacnoise of this name—the death of one being recorded at the year 759, and that of the other at 842. From the form of the cross, I am inclined to suppose this the tombstone of the latter, and therefore of the ninth century.

No. 86. An unfinished tombstone slab, without an inscription—the engraved lines representing a long-armed cross, with a small circle at their intersection.

No. 87. A small slab, on which the St. Cronan cross is inclosed in a square, thus resembling the ornamentation on some of our small cumdachs, or sacred boxes for holding relics. Above the cross are the letters Enꝺuñcoumbenınᵹ.

No. 88. Another slab, bearing a similar cumdach cross.

No. 89. Another slab, of the same type, with the letters Ahlıch above the box-like ornament.

No. 90. Part of a small quern-stone, with a cumdach cross engraved on it, but no inscription.

No. 91. A small slab, with a circle inclosing four Greek crosses, each inclosed in a small circle.

No. 92. A slab, bearing the name Maelıohaın Eꞃꞃ (*episcopus*). I could not discover any record of a bishop of this name having been buried at Clonmacnoise.

No. 93. Another small slab, with a cross, and bearing the letters Dınuıꞃᵹuꞃ ꝺeıc. To all appearance this inscription is perfect.

No. 94. The last sketch of the Clonmacnoise tombstones is that of one which bears evident marks of being of much more recent date than any of the foregoing. The form of the stone is somewhat coffin-shaped, and the ornamentation at its foot has quite a twelfth century look. The inscription is as follows:—Roın . Nu Loꞃꞃon.

Nos. 95–7. On the completion of the sketches of the Clonmacnoise tombstones I was struck by the fact that the letters presented many varieties of form; and in the following three illustrations I have given each variety; thus we see that the

Letter		Forms.	Letter		Forms.
a	has	15	l	has	8
b	—	6	m	—	2
c	—	5	n	—	5
ꝺ	—	7	o	—	5
e	—	9	p	—	1
ꝼ	—	8	q	—	1
ᵹ	—	5	ꞃ	—	16
h	—	9	ꞅ	—	2
ı	—	2	ꞇ	—	6

It is not improbable that by the form of these letters the dates of many of the tombstones might be roughly estimated, at least by centuries, as we know that the Irish form of letter varied from century to century, from the ancient Roman or Uncial character to the more angular and current form of the modern scribe.

I conclude this collection of ancient Irish inscribed tombstones by sketches of two from Arranmore, in the Bay of Galway:—

No. 98. The inscription on this slab consists of the following letters: Oꞃ . uꞃ Mclınach, and I found it lying near some ruins at the village of Onurcht.

No. 99. The tomb slab of St. Brecan, from the old church dedicated to the Holy Ghost. According to Dr. Petrie, this saint died in the sixth century.

Mr. SAMUEL FERGUSON, Q. C., read the following paper:—

ACCOUNT OF OGHAM INSCRIPTIONS IN THE CAVE AT RATHCROGHAN, COUNTY OF ROSCOMMON.

THE principal remains at Rathcroghan, formerly the residence of the provincial Kings of Connaught, are indicated on sheets 21 and 22 of the Ordnance Survey Map of the county of Roscommon, and have been described in some detail by O'Donovan in a note to his translation of the "Annals of the Four Masters," at A. D. 1223, and more fully in letters preserved among the MS. materials for the intended "Ordnance Survey Memoir," and now deposited in the Library of the Academy (14 F. 8, p. 191, *et seq.*).

Among these remains may be noticed on the map—310 yards north-west of the ancient sepulchral enclosure called Relig-na-Ree, or the Graveyard of the Kings—a spot marked with the name *Owneygat*, that is, the

Cat's Cave, of which the following account is given in the MS. letters above referred to:—

"There are two remarkable caves in the townland of Glenballythomas, of which the more remarkable is called Uṁaiꝺ na ᵹcaꞇ, because wild cats used to hunt rabbits in it. I walked into this a considerable distance, and saw its fine roof and hanging spars, like icicles, but will leave the description of it to geologists. The country people say that a woman followed a calf into this cave, and that she could not stop him till he came out at Keish Corran. I went as far into it as any one could, that is, until it terminated in a cleft, not wide enough to admit my head. This, according to tradition, was the Bank of Ireland in the time of Queen Mab; but if it was, the drops from the Gothic roof of the edifice must have injured the bank notes very much. A truer tradition connected with it is, that one Croghan, a rebel, lived in it after the rebellion, and by so doing saved his neck from the halter."

On examining this cave, on the 30th of September, 1864, the writer observed inscriptions in the Ogham character, on two of the roofing stones of its upper chambers or galleries. Part of the inscription on each stone was built into the structure, so that the stones before being placed must have been already sculptured. Whatever the age of the cave, the inscriptions must, therefore, have at least an equal antiquity.

The cave has always, within literary memory, been regarded as of the epoch of Meave, the celebrated Queen of Connaught, who lived about the beginning of the Christian era. The *Tain Bo Cuailgne*, or Cattle-Spoil of Quelgny, commemorates an expedition led by this heroine of antiquity into Ulster during the reign of Conor Mac Nessa, whose death is made, in Irish traditionary history, to synchronize with that of our Lord. She was daughter of Eochaid Fidleach, by whom the principal fort, or royal dwelling at Rathcroghan, is said to have been erected. Her name, which popular tradition has impressed on a great number of places in Ireland, is in its simplest form spelled MEDBH, equivalent to MEDF. Some one intimately connected with her family was called FRAECH. Such is the name given to her son-in-law in the ancient historical tract called the "*Tain-bo-Flidisi*," one of the introductory stories which constitute the preface to the *Tain-bo-Cuail̃gne*. She had many sons, by different fathers, and has left a vivid recollection of her name throughout the west of Ireland. That she lived at Rathcroghan at a period before the introduction of Christianity into Ireland is a fact which no one, in the present state of historical knowledge, will be disposed to deny.

The earliest notices of the cave appear to treat it as a treasury house of Meave and her husband Ailill. It is so represented in the *Tain-bo-Aingin*, another of the introductory or pre-tales of the *Tain-bo* of Quelgny. Such also was the tradition of the country in 1838, when O'Donovan made his communications to the Ordnance Office. The same idea still exists among the peasantry of the country, by whom the interior of the cave has been repeatedly explored within the last twenty years, in the hope of finding treasure. Their operations have resulted in the falling in of the earth, which now chokes up the western end of the cave, and renders it impossible to say how far it extends.

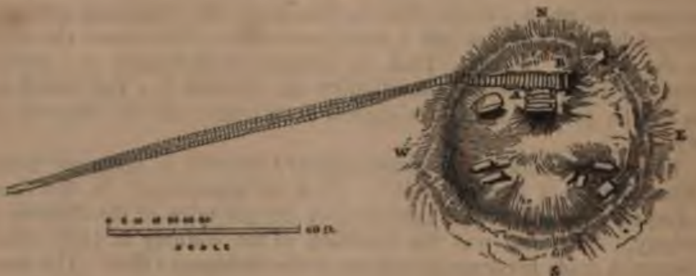
The writer is indebted to W. M. Hennessy, Esq., for the following further notes in reference to this cave:—

"In the list of celebrated places preserved in a stave of the 'Book of Leinster,' which is really a portion of the 'Book of Lecan,' the cave of Cruachan is described as one of the three caves of Ireland,—the other two being the cave of Howth, and the Derg Farna, now known as the cave of Dunmore, near Kilkenny. This tract, from its language, appears to be of very high antiquity.

"In the historical tale called the *Tain-bo-Ainghin*, or the Cattle Spoil of Ainghin, preserved in the 'Yellow Book of Lecan,' the cave of Cruachan is referred to as the residence of a fairy community; and some interesting particulars regarding the proceedings of its denizens are related by a person who, for some slight to a fountain fairy, was condemned to a year's residence therein."

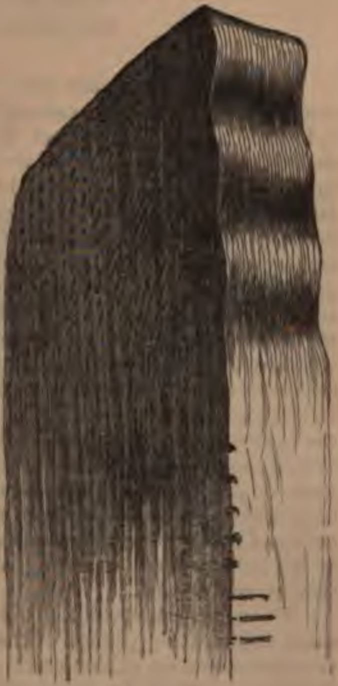
It consists of a natural fissure in the limestone rock, which appears to have been artificially widened, so as to give an average breadth of five feet throughout a distance of about forty yards. This cavern, the floor of which is from fifteen to twenty-five feet under the surface, is connected with the upper chambers, in which the inscriptions exist, by a passage excavated in the rock, and roofed over, as are the external chambers, by long stones, artificially placed, and bonded into the dry stone walls forming the sides of the passages or chambers near the surface. Whether these upper passages be entrances to the cave, or chambers to which the cave itself served as an entrance, may be a matter of doubt. They are two in number—one forming a prolongation, at a higher level, of the natural cavern, the other opening upon it at right angles. Around these openings exist the remains of a tumulus of about twenty yards in diameter. The subjoined woodcut exhibits the general appearance and disposition of the parts, the dotted lines representing the underground constructions.

Fig. 1.



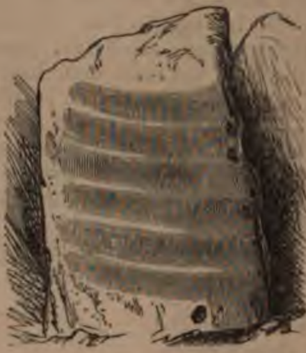
The traces of several interments remain about the margin of the tumulus; and one nearly perfect sepulchral cist exists within a few feet to the west of the lateral chamber, which now forms the principal approach. This chamber may be portion of a covered avenue, or it may be portion of a separate apartment. It is entered from a depression on the surface opening to the south, which bears the appearance rather of a breach made into the end of a chamber than of a passage. About seven feet in length of the covered part remains. The width is three feet eight inches; the height, from the clay which has fallen in, and forms the floor, not more than three feet three inches. At the junction of this crypt with the eastern opening, a species of transept is formed, about eight feet by four, and four feet high, extending eastward into the remains of what has now the appearance of a passage, and opening on the western side into the narrow gallery formed in the rock, which descends by a series of inclines and rude steps into the principal apartment below. In this lower interior the natural walls of rock rise to a height of about eighteen feet, converging at top, and having much the appearance of the inclined passages in the Mexican pyramids. The spaces between the rock ledges at top are, as are the upper passages and chambers, covered in with transverse blocks of stone. These stones, where they form the lintels at the junction of the upper chambers, have been selected with care; and it is on the lintel stone of the southern crypt, marked A on the plan, where it abuts on what has been described as the transept, that the principal inscription exists.

Fig. 2.



This stone, which is of the limestone of the neighbourhood, measures four feet eight inches in length, of which one foot is engaged in the adjoining masonry. It has an average breadth of one foot four inches, being somewhat broader towards the western end, and varies in thickness from four to nine inches. Its under surface is corrugated in the direction of its length with numerous natural striæ; and it does not appear to have undergone any preparation with the tool, except at one point, on the inner edge, at the eastern end, where it presents the appearance of having been rubbed down, so as to form two ribbed projections, separated by shallow grooved indentations, resembling the analogous work on one of the stones of New Grange, which has been figured in Wilde's "Beauties of the Boyne and Blackwater" (p. 194).

Fig. 3.

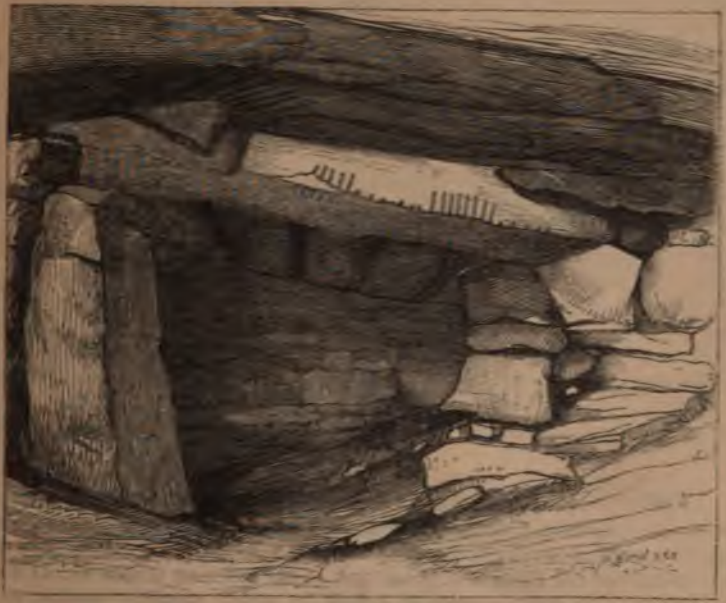


Ribbed Stone in gallery at New Grange.

Something of the same kind is also observable on one of the Ogham inscribed stones in the Academy's Lapidarian Museum, No. 5. These indentations, whatever object they may have had, appear to indicate that this is the upper end of the stone, and raise a probable conjecture that it originally stood upright. They are not carried across the face of the stone, nor do they appear on the opposite edge. Seven, or possibly eight, Ogham characters exist on the external edge and face, and ten on the internal edge and face of this lintel. The external appearance of the stone, with its inscription, is shown on the annexed woodcut, Fig. 4. There is, at the right hand, detached from the inscription, an indentation on the edge-line of the stone, too faint to be relied on with any certainty; but which may possibly be a single notch, standing for the vowel a. A circular disc or dot appears above this indentation on the edge near the end. This also is uncertain, and is not shown on the drawing. Two vertical strokes, connected with some curved indentations, apparently artificial, also exist on one of the stones forming the jamb or *quoin* of the passage on the right. They are too uncertain to be practically relied on, and are only hinted at in the woodcut. The character of these indentations has a general resemblance to that of some of the rubbed lines appearing on the stones of the chambers at New Grange and Dowth.

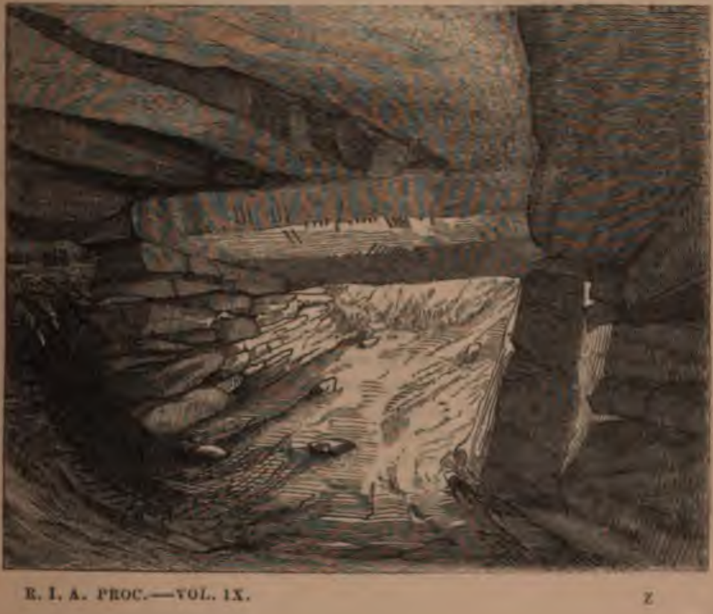
When first observed, the lintel was partly concealed by a block of stone, constituting portion of the eastern side wall, and covering part of the final character at that end. The removal of this block enabled the writer to examine the whole under surface and edge, and to state that no further inscribed marks exist upon it.

Fig. 4.



The internal appearance of this lintel is shown below.

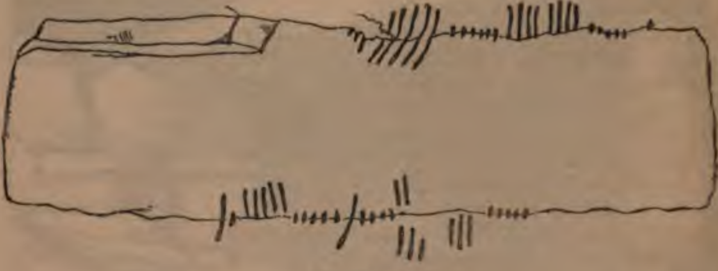
Fig. 5.



The extended inscription is also given, so as to exclude the errors incident to perspective.

Fig. 6.

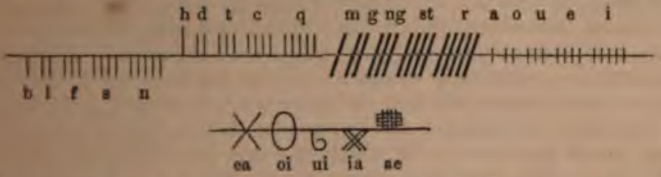
Outer Edge.



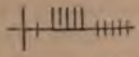
Inner Edge.

Before proceeding further in the consideration of these characters, it may be interesting to those members of the Academy who have not given special attention to the subject, that something should be said of the nature of the Ogham writing, and of the existing means for its deciphering. It was a species of cipher, in which straight strokes engraved on monumental stones, by their number and relation to a particular line, called the stem-line (generally formed by the edge of the stone), represented the letters of an alphabet. Facility of engraving with rude implements, rather than a desire for secrecy—for who would desire to commemorate in signs not generally understood?—may have been the original motive for the use of this species of writing. The value of the characters depending on the number of strokes, and these numbers increasing in a progressive ratio in sets of five—that is, five groups below, five above, five obliquely across, and five directly across, or on the stem-line—it is obvious, that if purposes of secrecy or curiosity were desired, the cipher might be made more or less abstruse by varying the number of the strokes; as by beginning with two or more at the commencement of each series; and a great number of examples of such cryptic Oghams may be seen in the tract on this subject in the "Book of Ballymote." They are all, however, resolvable into the original key-cipher, in which each set of five commences with a single stroke; and which, with the other more complex examples, and certain arbitrary marks for vowel combinations, is also found in the same depository. With this key, available for the last five hundred years, we may be surprised to find the Ogham character still involved in so much mystery. This may be, in some measure, accounted for by the discredit brought on the subject by a paper in our own "Transactions," at an early period in the history of the Academy, in which a supposed passage from one of the Ossianic poems was adduced in elucidation of an Ogham inscription existing on Callan Mountain, in the county of Clare

("Transactions R. I. A.," vol. i., Antiq., p. 3). The passage appears to have found its way into the text from a modern source; and the charge of falsification extended itself, with questionable justice, as it seems to the writer, to the inscription itself. Added to this disaster at the outset of the inquiry, were the really great obstacles arising from the singularity of the names, and from the absence of any clue to the sequences in which the writing ran, whether from top to bottom, from left to right, or *vice versâ*. It was not till our President undertook the investigation in the character on the scientific principles applicable to cipher-writing in general, that the subject again attracted a philosophic interest. His results, arising on independent analysis and comparison, are understood—for as yet the complete paper has not been published—to have come out in substantial accordance with the old key; and in a short paper in our "Proceedings" (vol. iv., p. 358), he adopted and published the "Ballymote Key," which, with some slight difference, had also been given by Dr. O'Donovan in his "Irish Grammar," and by other earlier writers.



In the course of these investigations our President early identified the group,



reading *Maqui*, as the genitive form of *Mac*, a son—a conclusion which was destined to receive corroboration of the most convincing kind from a source not then known to be in existence. The writer here refers to those monumental stones of Wales, which bear inscriptions in Roman characters with accompanying Oghams. These Oghams, rendered according to the key so furnished, have been found to yield results confirmatory not only of the alphabetic force of the characters, but of their proper sequences and collocations, as indicated by the independent method of investigation employed by our President. The Welsh Oghams so tested have, in fact, been found to resolve themselves into an echo of the correlative Roman writing. One of these inscribed Welsh pillars, which may be justly called the Rosetta Stone of the investigation, is in effect both bilingual and bi-literal. It commemorates in Latin words and Roman characters a person called Sagrân, son of Cunotam, in the form (Lapis) *Sagrani Fili Cunotami*. An Ogham on the edge of the same stone reads *Sagramni Maqi Cunotami*. Here we have *Maqui* as the equivalent of the Latin *Filii;* and must acknowledge the conclusion to be very cogent that in Irish monuments of a cognate kind, wherever we find the combination of Ogham characters which sounds "*Maqi*," we may expect, before it, the name of the person commemorated, and, after it, the patronymic of that person. Such, in fact, is the formula of commemoration found on great numbers of the Irish Ogham monuments. The writer instances in our own lapidarian Museum, No. 7, *Qunilogni Maqi D * * *; Nocati Maqi, Maqi Rett * **, No. 11; and in Mr. Du Noyer's collection *Logoqi Maqi Erenan* (Du Noyer MSS. Lib. R. I. A., vol. i., No. 43). *Erc Maqi Maqerti*, ibid., No. 27; *Lafi cas Maqi Muce*, ibid., No. 27); and numerous similar examples in the publications of the other Irish Archæological Societies.

The presence of this well-known combination of strokes and notches, reading MAQI, at the western end of the legend on the inner edge of the Rathcroghan stone, taken in connexion with the other indications of that being the lower end of the stone, and with the generally observed rule that these inscriptions read from bottom to top, and from left to right, leaves no reasonable doubt that the remainder of that line contains the patronymic, and the line on the opposite side the name, of the person commemorated. Reverting to the opposite side, and reading it from bottom to top, and from left to right, and according to the ordinary key, it presents a combination of characters, of which – R – CCI are free from doubt, and of which it is not impossible that the three strokes occupying the place of the first blank represent F, and the notches occupying the place of the second blank stand for AI; in which case this part of the legend would read FRAICCI. The difficulty in respect to the first set of characters arises from a fracture of the stone, which leaves it in doubt whether the third stroke crossed the line of the edge. In that case, the reading would be OMR – CCI. The six notches represented by the second blank may either be a double U, or may read EO, or OE, or in any of the combinations of AUO. The name, whatever it be, seems to be in the genitive form, and to imply some such expression as "the stone of" before it.

Leaving this portion of the inscription, and coming to the patronymic, it is certainly startling to find it read, as it does in this collocation and sequence, without doubt or difficulty,

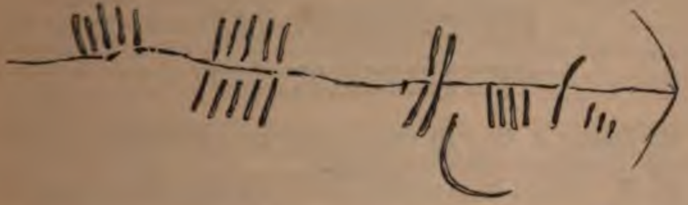
MEDFFI,

—that is, collating the several parts of the legend,

"(The stone of) [FRAIC?] son of Medf."

The second inscription is found on one of the lintels covering the eastern passage, marked B on Fig. 1. When first observed, four of the characters and part of the fifth were hidden under the face of the stone, where it lay bedded on the southern jamb of the passage; and it was not until it was raised, and turned on its side, that they were, for the first time since the construction of the cave, offered to human observation. The appearance of the sculpture seems to indicate long exposure to the weather prior to the deposit of the stone; and goes to support the conjecture suggested by the ribbed appearance in the other, that both these lintels may have been monumental pillar-stones, brought not improbably from the adjoining cemetery of Relig-na-Ree. The inscription consists of eight characters, two of whch stand somewhat detached, yet seem to require collocation with the others to render an articulate sound.

Fig. 7.



The Key-word MAQI does not exist here to assist us; but a curved character occurring near the end of the group indicates that it is to be deemed under the stem-line, and that consequently the detached characters above referred to are those from which the reading commences. The writer is not aware of any other example of the curved character in any existing monument; but it is one of the contractions given in the recognised Ogham keys, having the value of the vowels UI. The last character to the right is extremely faint, and the writer is unable to say with certainty whether it consists of three or of two indentations. It appeared, however, to the eye and touch rather to consist of three strokes and these below the stem-line; but as F would not articulate with the next adjoining character (M), and the strokes are short and notch-like, he inclines to suppose it the vowel U, a not unfrequent termination of proper names in Oghamic writing. Taken in this sequence, the legend on this second stone would read

QRAGUISMU.

The writer is not aware at present of any corresponding proper name. Names beginning with the same combination are, however, found on some of the inscribed stones in the Academy's collection, as

QRITTALEGI QRITUMAH,

on stone, No. 5. In the absence of anything more satisfactory we can, therefore, conclude no more from this object, than that Ogham writing was certainly in use prior to the construction of the Cave of Curachain.

But, as regards the lintel first described, the legend of "Tihe Son of Medf" appears to stand plainly legible, according to the ordinary key, and in the ordinary course of collocation; and, taken in connexion with the place and its traditions, may afford a confirmation of the testimony of our old books to the use of alphabetic writing in the Ogham character at a period before the introduction of Christianity.

On the seemingly Latinized form of the inflections, and the feminine genitive in *i*, the writer desires to submit the matter to more competent philologists; and, with regard to the probable age of the cave, and the appearance it presents of having had two entrances, refers to Keating's tract on "Early Irish Modes of Sepulture," from the *Tri Biorr-ghaethe an Bhais* ("Irish Ossianic Society's Transactions," vol. i., p. 63, *et seq.*), and in particular to the old poem there cited :*—

Feart aen dorus d'fior go naoi,
Feart go n-dó ḋóirsiḃ do mnaoi.

A grave of one door for a man of science;
A grave of *two doors* for a woman.

Mr. Eugene A. Conwell read a paper (in continuation) "On the Ancient Remains at Sliabh-na-Callighe."

Mr. H. F. Hore, by permission of the Academy, read a paper "On Banshees."

The Academy adopted an Address to His Excellency the Lord Lieutenant, brought up from the Council by the Secretary.

STATED MEETING.—Wednesday, November 30, 1864.

The Very Rev. Charles Graves, D.D., President, in the Chair.

The Secretary reported that the Address of the Academy to His Excellency the Lord Lieutenant, adopted on the 24th of November, was presented by the President and Members, at the Viceregal Lodge, on Thursday last, the 24th inst.

Whereupon it was

Resolved,—That the Address to the Lord Lieutenant, together with His Excellency's Answer, be printed in the Proceedings.

Address to His Excellency the Lord Baron Wodehouse, *Lord Lieutenant General, and General Governor of Ireland.*

May it Please Your Excellency,—We, the President and Members of the Royal Irish Academy, respectfully desire to present to Your Excellency our hearty congratulations upon your arrival in Ireland as the representative of our most gracious Sovereign.

In virtue of your high office, Your Excellency becomes, under our Charter, the Visitor of the Academy. We are thus privileged, as a body incorporated for the promotion of the study of Science, Polite

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* Since making the above communication, the writer has been informed by Richard R. Brash, Esq., Sunday's Well, Cork, that Mr. Brash, accompanied by J. Windele, Esq., Cork, observed the Ogham inscription on the stone marked A, on a visit to Rathcroghan in the year 1852.

Literature, and Antiquities, to enter into dutiful relation with a Nobleman whose love of learning and brilliant career in its cultivation have shed additional lustre on the honours of his ancient lineage.

From a small beginning, in the year 1786, our Society has steadily increased in numbers and importance, till it has attained the rank of a national institution; and while the threefold object of its foundation has opened a wide field for intellectual exercise, it has produced the happy result of bringing together, from time to time, in friendly intercourse and united action, a large portion of the literary public, the variety of whose pursuits, or other accidental differences, might, but for such a medium of communication, have placed them in a condition of antagonism or indifference.

With what measure of success the scientific and literary labours of the Academy have been conducted, it is not for its members to pronounce. But they may be permitted to apprise Your Excellency that in two collateral publications, the "Transactions" and the "Proceedings," are embodied the principal results of their investigations; and that these journals have a wide circulation at home, and among kindred institutions on the Continent. The creation of a Celtic Museum, unequalled in extent and variety, and the formation of a Library peculiarly rich in Irish Manuscripts, have also marked the growth of our Society.

The Academy has to record, with a lively sense of gratitude, the encouragement and favour it has received at the hands of successive Chief Governors of Ireland, and especially of Your Excellency's illustrious predecessor, who, himself possessed of the most remarkable gifts and accomplishments, was ever ready to assist the intellectual labours of others. We earnestly hope that one so noble-hearted and so richly endowed may long be spared to humanity and literature.

We trust that Your Excellency's administration of the high office committed to you by our beloved and most gracious Sovereign will tend, not only to promote the peace and prosperity of Ireland at large, but also to impart increased vigour and efficiency to her literary institutions; so that, while as subjects and citizens we enjoy the blessings of living under a just and able ruler, we may as an Academy experience the benefit of connexion with a Viceroy who has proved himself an accomplished scholar and an enlightened statesman.

To which His Excellency returned the following Answer:—

Mr. President, and Gentlemen of the Royal Irish Academy,—Amongst the various bodies which have presented Addresses to me on my assuming the office of Lord Lieutenant, I can say with truth that I have received none with greater satisfaction than the Royal Irish Academy.

A Society which has with so much success brought together the most distinguished literary and scientific men in Ireland, and whose "Transactions" and "Proceedings" enjoy a wide reputation at home and abroad, would command my attention and support, even if I did not hold the official position of Visitor to the Academy.

Though I have not yet had the opportunity of becoming personally acquainted with your Museum and Library, I am well aware of the important and interesting character of those collections; and the care and assiduity with which you have gathered and preserved the relics of bygone ages are at once a subject of congratulation, and a bright example to all who study the history of the ancient races of mankind.

I shall rejoice if my connexion with the Academy should enable me to afford that encouragement to its labours which you derived from my accomplished predecessor; but I am conscious that my own literary acquirements are far too modest to entitle them to the commendation of so learned and distinguished a Society.

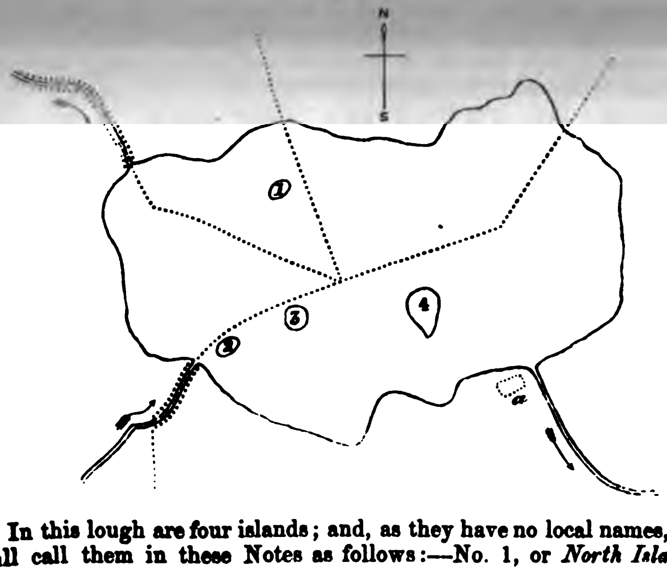
G. Henry Kinahan, F. R. G. S. I., Senior Geologist of the Geological Survey of Ireland, read the following Paper:—

Notes on Crannoges in Ballin Lough.

Ballin Lough is situated in the parish of Ballinakill, barony of Leitrim, county of Galway, Sheet 125, and on the junction of Sheets 116 and 125 of the Ordnance Inch Map of Ireland. It lies a little more than half a mile south-east of Marble Hill, the seat of Sir T. J. Burke, Bart.

BALLIN LOUGH (COPIED FROM THE ORDNANCE SIX-INCH MAP).

Fig. 1.



In this lough are four islands; and, as they have no local names, we shall call them in these Notes as follows:—No. 1, or *North Island*;

No. 2, or *West Island*; No. 3, or *Middle Island*; and No. 4, or *East Island*. (See Figs. Nos. 1 and 2.)

Through the kindness of J. Hemsworth, Esq., of Danesfort, who placed his boat and man at my disposal, I was enabled to examine them during March, 1864, and found that Nos. 2 and 3 are Crannoges, or artificial islands, while No. 4 may be one.

No. 1, or North Island.—This, by the Ordnance Survey Map, is about 280 feet from the north shore; but during the dry season it can be approached by a peaty, reedy bank which runs from it towards the N.-E. It is of a rude oval shape, the diameters being twenty-five and sixteen yards long. When visited, it was about a foot above the surface of the water, and we excavated for over four feet in depth through peat without finding any traces of ancient occupiers; and as there are no stones round the outside of it, we came to the conclusion that it was not artificial.

No. 2, or West Island.—This lies about 80 feet from the shore, to which it is joined during the dry season. It is of a rude oval shape, the diameters being about 33 and 15 yards; the outside is regularly covered with flat stones. Most of it was covered with water when it was visited; we therefore excavated in the centre, where we found—

Section No. 1.

		Ft.	In.
Bog and clay, with a few bones, ...		2	0
Wood ashes, full of pieces of charred bones, .	over,	1	6
		3	6

No. 3, or Middle Island.—This lies about 500 feet from the nearest shore, and 250 feet from the West Island. It is nearly round, and about 32 yards in diameter. Outside it, for a width of about four yards, there are regularly placed flat stones; and we were informed by the fishermen of the lake that during the summer, when the water is low, piles can be seen all round it; but, as the water was high at the time of our visit, they could not be seen.

On account of the height of the water and the porous nature of the materials forming the island, we could not make a careful examination; but near the west shore, where the island was a foot above the surface of the water, we made a small excavation, and found—

Section No. 2.

		Ft.	In.
6. Peat and clay, ...	about	0	9
5. Peat and stones, with a few bones, ...	,,	0	9
4. Wood ashes and peat, with thousands of unbroken cherry-stones, a few broken hazel nuts, a few broken bones, teeth, and a ball of red colouring matter, ...	,,	2	6
3. Basket floor, about one and a half inches thick, . .	,,		
2. Sawn oak beams, 8 by 6 inches, ...	,,	0	6
1. Peat, ...	over	0	6
		5	0

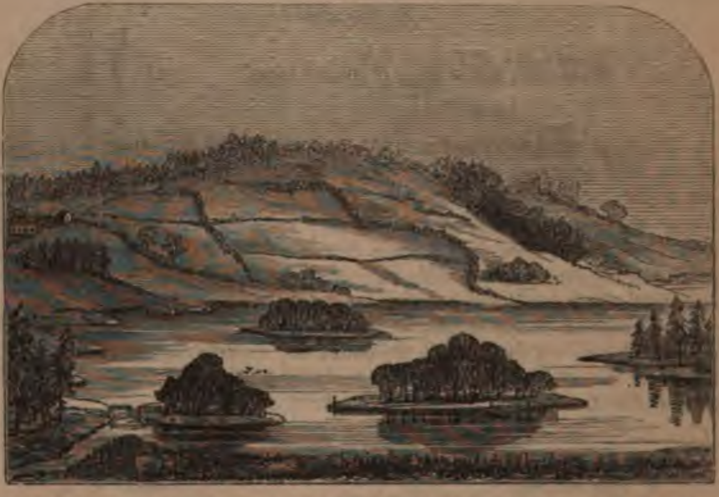
The oak beams (No. 2, section 2) were evidently sawn, not cut with a chopping instrument. Through them, at about nine inches apart, there were pairs of dowels that were used to fasten the basket flooring to them; these beams seem to run nearly N. and S.

In the basket flooring, at about every nine inches, were poles, 2·5 inches thick, through which the previously mentioned dowels went, and fastened the flooring to the beams. These poles seemed to be ash saplings, while the rest of the flooring was made of hazel rods. Below the beams there was peat, but it could not be examined on account of the quantity of water that rushed into the working. This Crannoge seems to have been divided into huts or apartments, as part of a row of ash piles, three inches in diameter, was observed.

No stone or other implements were found, nor was it likely that there should, as only a small opening was made, and only a few feet of the basket flooring uncovered. To find them, the Crannoge ought to be carefully explored during the summer, when the water would allow the bed lying on the flooring to be cleared out.

SKETCH OF BALLIN LOUGH, LOOKING N. E.

Fig. 2.



The island in the middle distance is No. 1, or North Island; that on the left hand, over which there are birds, is No. 2, or West Island; the island on the shore of which a boat is seen, is No. 3, or Middle Island; and a small portion of No. 4, or East Island, is seen at the right-hand margin of the sketch.

No. 4, *or East Island.*—This lies about 300 feet from the south shore, and is of an irregular pear shape, being about sixty-seven yards in length from north to south, and fifty yards in its widest part from east to west. Round outside this island for about four yards in width there are regularly placed small flat stones; and at the S.-E. shore of the island (under the water at the time we visited it), there is an east and west beam seven inches wide. These things would seem to point to its being artificial; but we made various excavations in different parts of the island, and found no traces of ancient inhabitants; an excavation in the centre of it gave us four feet of peat, under which was shell marl. From this I am inclined to think that this island may have been partly natural, and partly artificial.

Ballin Lough occupies a hollow among low hills, the only exit from it being on the S.-E., at the village of Ballinlough, where there is an artificial cut about four feet deep through a bank of coarse stony drift (*boulder clay*), about sixty yards wide. If this cut was filled up, the waters of the lake would rise at least four feet higher than at present; and that the water was at this level not long since, would seem to have been the case, as all round the lake to over that height there is a deposit of shell marl and peat. As the level of the water when the island was examined was three feet above the basket floor in the Crannoge, it must have been at least seven feet above the floor before the cut was made through the bank of drift. From this we see that when the Crannoges were built, the water of the lake must have been at least four feet lower than in March, 1864, and at least eight feet lower than the height of the water before the artificial cut was made; how the waters could have been at that level we have now to consider.

On the Ordnance Maps we find that the height of the lake is 356 feet above their datum level, and that a quarter of a mile to the S.-E., in the townland of Tulla, the surface of the stream is 340 feet. From this we see that if a cut was made from this point, it would lower the lake sixteen feet; or thirteen feet lower than the basket flooring of the Crannoge; and if we examine the stream, we will find that the rise from this point to the village of Ballinlough is only a few feet, while from the village to the lough it is very rapid, being over eight feet. From this we see that if there had once been a natural cut or ravine through this bank of drift from the village to the lake, the waters of the latter would have been five feet below the basket flooring of the Crannoge. On examining the bank of drift on the west of the village, what may be the trace of an ancient ravine will be observed, which appears to have been *artificially filled up* with stuff taken from an oblong excavation, marked *a* on Fig. No. 1, about three or four yards wide, and about six or eight yards long, and that the ravine since it was filled up has been used as a road, which has helped to obliterate the old embouchement of the lake. To account for this artificial filling, I would suggest that the inhabitants of the Crannoge were flooded out by an enemy who stopped the egress of the lake, and thus raised the waters until the islands with the huts and inhabitants were swamped. The islands after this were submerged until the present cut was opened, when they again appeared. In latter years they have been occupied by various individuals, generally for illicit distillation.

In the lake the horns and skulls of the Red Deer have been discovered at various times, and the head and horns of the Irish Elk are also said to have been found; but for the latter there is no good evidence.

I should be inclined to consider that these Crannoges are not as old as those which I previously described as occurring in Lough Rea; for in the Lough Rea Crannoges the piles and beams all appear to have been split, while in the Ballin Lough Crannoge the beams were undoubtedly cut with a saw. That there was an ancient settlement hereabout, and that it was a place of note, seems to be proved by all the ancient remains scattered about, which will be seen on looking at the Ordnance Map (*Galway Sheet*, 125), as within a mile of the lake are thirteen Raths and Raheens, eight Cromlechs, and one Holy Well (Tobermacduagh). All the Cromlechs and the Holy Well lie to the N.-W. in Marble Hill Demesne, the ancient name of which was Gortenacuppoge, *i. e.*, "The Field of the Leaves;" and most of the Raths and Raheens lie to the N. and N.-E., only three (which are Raheens) on the south.

At a more recent period it would appear that this neighbourhood was still a place of note, as about three miles to the north-east there are the ruins of an extensive abbey and castle, and a mile on the north are the ruins of a church and castle. The abbey may have been founded by St. Colman M'Duagh, as the Holy Well previously mentioned is dedicated to him.

I may here mention that Sir W. Wilde, in his list of recorded Crannoges in the Catalogue of the Royal Irish Academy, says:—"Even so late as 1610 we read of Crannagh Mac Knavin, in the parish of Tynagh, barony of Leitrim, and county of Galway." I could find no trace of this Crannoge; but I imagine its site must lie somewhere in the large alluvial flat and bog which occupies the country south and south-west of Crannagh, the seat of R. Nugent, Esq., which is in the parish of Tynagh, and barony of Leitrim, and lies about half-way between Portumna and Marble Hill. It is remarkable that, although it was inhabited up to so late a period, and that the descendants of the sept of the Mac Knavins still live thereabouts, I could find no tradition about it in the neighbourhood, and the only trace the name of Mr. Nugent's place. These flats and bogs, somewhere in which I suppose the site of this Crannoge to be, lie between four and five miles E.-N.-E. of Ballinlough, where are situated the Crannoges which the Notes just read refer to.

The following paper was also read:—

NOTES ON A CRANNOGE IN LOUGH NAHINCH. By H. B. TRENCH, ESQ., and G. H. KINAHAN, F. R. G. S. I.

LOUGH NAHINCH, i. e. *The Lake of the Island*, lies on the junction of Tipperary and the King's County, the Crannoge being situated in the former, barony of Lower Ormond, parish of Ballingarry, Sheet 11 of the Townland Survey of Tipperary, and Sheet 135 of the One-inch Ordnance Map of Ireland.

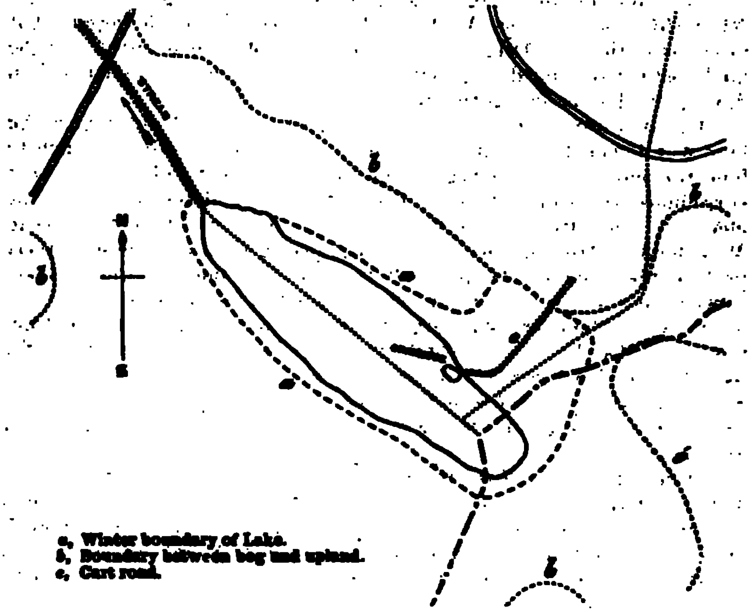
This lake lies in a large bog basin (*see Geological Map of Ireland, Sheet* 135 *and Map Fig. No.* 1), and was formerly much larger; but previous to the year 1812, its outlet to the N.-W. was lowered, and the land about it reclaimed. In winter its limits extend much farther than during the dry season, as the ground about it is low.

The appearance of the Crannoge has been much changed since the lake was lowered, as on its south shore a quay was built on which to land turf cut in the peat bog on the south, and many of the piles that surrounded the Crannoge have been removed, and its circular shape changed. Our attention was first directed to it by the following notice in Wakefield's "Ireland," which was published in 1812:—"In the highest part of this reclaimed land, which is about the middle of the old lake, there is seen a circular part, in shape the top of an immense tub, about sixty feet in diameter. The large planks which form the staves are from one to two feet broad, and about six inches thick, quite straight as far as it has yet been possible to trace them downwards. None of them have yet been raised without cutting them. At present there is no appearance of either ax or saw having been used in the formation of them."

When the island was visited in March and August, 1864, it was found to have shallow water all round it, except at the south, where the previously mentioned quay was built; on the east there is a track into the mainland (C *on Map Fig.* 1), that may also be of modern construction; at all events, it was used at the same time as the quay, and has been repaired from season to season, by laying branches and trunks of trees across it, and covering them with gravel. At the junction of this track with the quay at the S.-E. of the island, one of the old oak sheeting piles was remarked, the section of it being 4 × 12 inches. On the north of the island more of these piles were noted, forming part of a circle; and from them, running S. and S.-E., are two rows of round perpendicular ash piles, 2·5 inches in diameter, that appear to have been parts of two partitions or walls that divided up the space inside the circle of sheet piles into rooms or habitations. On the N.-W. of the island, about three yards from the present shore, are also some of the circle of sheet piles, and between them and the land are, E. and W., beams about four feet apart, and about four feet lower than the surface of the island. There are also above these, and close to the edge of the island, irregularly laid logs of oak, on an average about five inches in diameter, mingled with large stones. On the S.-W. of the island there is a set of oak sheet piles bounding the end of the quay; these seem to have been recently put here, and may have been some of those mentioned in the extract before quoted, "that were raised" when the quay was built, and were redriven here to protect the pier. There are also a few other piles, but they are evidently modern, being round fir sticks, which appear to have been used to fasten the boats to.

LOUGH NAHINCH.

Reduced $\frac{1}{5}$th from the Ordnance six-inch Map, equal to 4$\frac{8}{10}$th inches to the mile.


N
S
a
b
c
a, Winter boundary of Lake.
b, Boundary between bog and upland.
c, Cart road.

The difference between the level of the water of the lake in March and August was only about a foot, or a foot and a half; and the island is of such a porous nature, that the water rushed in everywhere, and prevented satisfactory work; but we opened small excavations in various places, and found the general section of the island to be :—

General Section.

		Ft.	In.
6. Bog, ...	about	0	6
5. Bog, ashes, bones, and nuts, ...	„	1	6
4. Stones and large oak sticks irregularly laid, . . .	„	0	6
3. Peat, bones, and ashes, in which are oak beams lying in different directions, ...	„	1	6
2. Nearly E. and W., oak beams, about four feet apart, .	„	0	6
1. Peat, wood chips, and bones, ...	over	1	0
		5	6

From this it is seen that the artificial work, measured from the present surface of the island, is more than 5·5 feet in thickness. On the beams (*Bed No.* 2 *in Section*) there seems to have been a basket flooring, but of this we could not be certain, on account of the depth of water in the excavation; but in connexion with them we observed *wicker walls*, made of hazel rods. Where the wicker walls cross the oak beams, there were round holes through the latter for the stakes to go through. In the vicinity of these beams a small rude stone implement made of Silurian grit was found, but it was so rotten, that it broke while the dirt was being removed from it.

The beams in bed No. 3 were charred on the under surface as if they had been the beams which supported the roof of an edifice that was destroyed by fire; near the north of the island, immediately over these charred beams, there was a N.-W. and S.-E. plank about ten feet long, twenty inches wide, and two inches thick; at about one foot nine inches from its N.-W. end there were two holes through it, four inches by two inches, that ran north and south in a line with the north and south piles seen on the north shore, and on each side of the plank were upright stakes ranging in the same direction. In bed No. 5, near the centre of the island, a large heap of wood ashes was found, and innumerable quantities of hazelnut shells and a few of walnuts. The bones found in the different beds seem to be those of pigs, sheep, and cows.

From the facts we were able to collect, we may draw the following conclusions:—That the base of the artificial work is more than 5·5 feet below the present surface of the island; that it was inhabited *at least* at two different periods, the first of these being when the east and west beams formed the floor of the habitations; those habitations seem to have been destroyed by fire, which would account for the charred beams. After this period the oak sticks and stones irregularly laid were placed to form a floor for new habitations. Between these periods we must suppose that the waters of the lake rose considerably.

Within a mile of Lough Nahinch we find that there are the remains of nine *raths* and *raheens* in the county of Tipperary, and five or six in the King's County; that there were more would seem likely, as the name of the townland on the south of the lake is Lissadonna, and yet there is now no trace of a *liss* or *rath* in it; and in other places raths are said to have been levelled with the ground. The old castle at Ballingarry lies about a mile N.-W. of the lake; it may have been built to prevent the natives from re-occupying their island home.

The Very Rev. the PRESIDENT read a paper

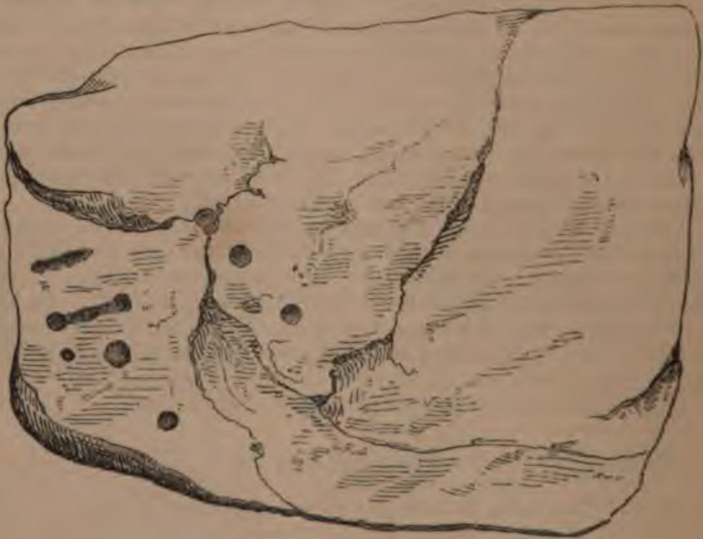
ON INSCRIBED MONUMENTS IN THE COUNTY OF KERRY

(Lately discovered by himself and his son, Mr. Alfred Graves).

THE monuments now brought under the notice of the Academy appear to be nearly related to a class which formed the subject of a paper read by Dean Graves to the Academy in February, 1860. The monuments then described exhibited inscribed circles, or groups of concentric circles, having at the centre small cup-shaped hollows, of from two to four inches in diameter. The monuments to which attention is now directed present numbers of the cup-shaped hollows, unaccompanied by circles.

Five of them are the covering stones of large cromlechs, and Dean Graves thinks that there is reason to believe that the hollows were designedly arranged in certain alignments. The monuments, however, have been so much defaced by the action of the weather during hundreds, perhaps thousands of years, that it is hardly safe as yet to insist positively upon this point.

Dean Graves remarks that the occurrence of these symbols on what are undoubtedly sepulchral monuments may help towards the discovery of their signification. A huge block, found by Mr. Alfred Graves, at Loher, near Darrynane, and exhibiting some of these hollows, serves as the covering stone to a sepulchral chamber excavated in the earth under it; a narrow covered gallery, of twenty-four feet in length, constructed in the ordinary way, leads to the subterraneous chamber. Though careful search was made in it for human or other remains, nothing was found, with the exception of a few fragments of charcoal, and a portion of a charred bone.

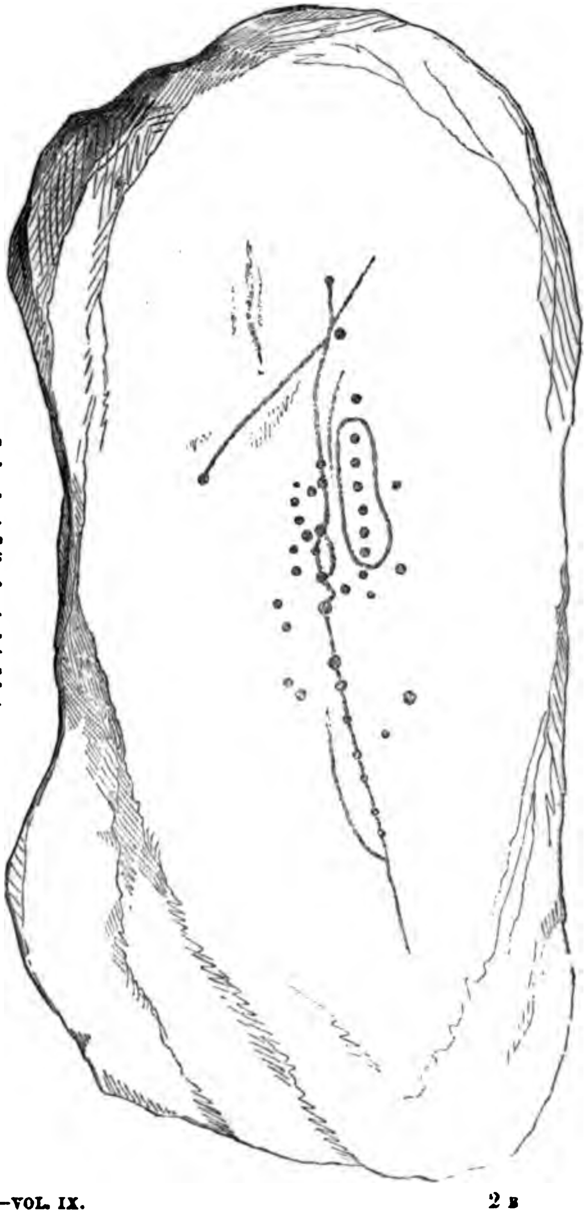


Scale, $\frac{3}{16}$th of an inch to 1 foot.

The other monuments described in Dean Graves's paper were found in the following localities:—One in the island of Valencia; another, near Cahirciveen; a third, near Waterville bridge; and two more, near Sneem.

The Dean concluded by expressing his expectation that artificial hollows would be found on many of the covering stones of cromlechs on which they have not been yet observed, simply because their existence was not suspected. Where the surface has been much affected by the weather, any hollows that appear may be readily mistaken for natural ones; but hollows that are certainly artificial having once been recognised, the eye of the antiquary will be prepared to observe those which are not so obviously the work of man.

Dean Graves noticed some other monuments in Kerry which exhibit circular hollows, but do not admit of being classed along with those described in this paper.



Scale, about $\frac{1}{30}$th of an inch to 1 foot.

Mr. George C. Garnett read a paper "On Deep-sea Soundings."

The Secretary read a paper by Mr. George J. Knox "On the Composition of Cadmium, Arsenic, and Nitrogen."

MONDAY, DECEMBER 12, 1864.

John F. Waller, LL. D., Vice-President, in the Chair.

P. Joseph Keenan, Esq., was elected a Member of the Academy.

Denis H. Kelly read the following paper:—

Description of two Irish MS. Tracts by the Celebrated Duald Mc Firbis, transcribed by W. Hennessy, Esq.; and presented by him to the Royal Irish Academy, through D. H. Kelly, M. R. I. A.

Mr. President and Gentlemen,—Mr. William Hennessy has intrusted to me, for presentation to the Academy, this small Book, containing faithful transcripts, with the contractions resolved, of two Tracts compiled by the celebrated Duald Mc Firbis, the Amanuensis of Sir James Ware, the originals of which are preserved in the Bodleian Library, at Oxford, where Mr. Hennessy discovered them in the month of August last.

The MSS. from which these copies have been transcribed are in the beautifully minute and well-known handwriting of the learned and industrious D. Mc Firbis; and, although their contents are comprised in the small volume which I now submit to the Academy, the labourers in our wide field of Irish Archæology will, I believe, find in them much that is well worthy of careful examination.

I feel some gratification myself in having suggested to Mr. Hennessy the importance of a careful examination of the Irish MS. collections in both the British Museum and the Bodleian at Oxford, on the occasion of his kindly undertaking for me to collate my transcript of an Irish MS. in which I am interested with its original in the British Museum; and I believe that the volume which forms the subject of my observations this evening is only an instalment of the fruits we may look for from Mr. Hennessy's visit.

It will be unnecessary for me to trouble the Academy with any observations on the character of Duald Mc Firbis, and the nature of his contributions to Irish history, topography, and genealogy. It is well known that he was the lineal descendant of the learned compilers of the Book of Leacan, the hereditary ollamhs in history and genealogy of the Hy Frachrach of the Moy; and those who wish for further information on the subject will find it on referring to our friend Dr. Petrie's Notice in vol. xviii. of the Academy's "Transactions," of our lamented friend O'Donovan's archæological volume on the Tribes, &c., Hy Fiachrach; and to our equally lamented friend Eugene

O'Curry's Lectures, in which such particulars of Mc Firbis's life and writings as were then ascertainable have been faithfully set down. I may observe, however, in explanation of the manner in which his MS. collections became so widely dispersed, that after the death, in the year 1666, of his patron Sir James Ware, of whose house he had for for some time been an inmate, he appears to have returned to his native place in the county of Sligo, leaving most, if not all, of his MSS. in the hands of Sir James Ware's son and heir.

It is pretty generally known that all Sir James Ware's MS. collections relating to Ireland were purchased from his son Robert, in 1686, by Lord Clarendon, then Lord Lieutenant of Ireland.

After his Lordship's death they passed by sale into the possession of the Duke of Chandos, whom the witty and public-spirited Swift, Dean of St. Patrick's, in vain solicited to deposit them in the Library of Trinity College: his letters are given in the recently published correspondence of Mrs. Delany (Mary Granville), to whom he thus writes in October, 1734:—

"Are you acquainted with the Duke of Chandos? I know your Uncle Lansdowne and he were intimate friends. I have known the Duke long and well, and thought I had a share in his common favour; but he hath lately given me great cause of complaint.

"I was pressed by many persons of great learning here to write to his Grace, that having some old records relating to this kingdom, which were taken from hence by the Earl of Clarendon, who was Lieutenant here, and purchased them from private owners, and are now in the Duke's possession, that his Grace would please to bestow them to the University here; because Irish antiquities are of little value or curiosity to any other nation.

"I writ with all the civility in my power, and with compliments on the fame of his generosity, and in a style very different from what I use to my friends with titles; but He hath been pleased to be silent for above six weeks, which is the first treatment I ever met with of that kind from any English Person of quality, and what would better become a *little Irish* Baron than a *great English* Duke.

"But whether grandeur or party be the cause I shall not enquire, but leave it to you; and expect you will employ 'my Brother Lansdowne' (His Lordship will tell you, why I give him that Title), if He still converses with the Duke, to know the reason of His treatment. And you shall be my instrument to find it out, altho' it should cost you two shillings for a Chair.

"Jn. Swift."

In the following month of February he writes again to the same correspondent:—

"I am very much obliged to your care about that Business with the Duke of Chandos. I hear he told a person he would grant my request, but that he had *no acquaintance with me.*"

"J. S."

These MSS. underwent a second dispersion, by public auction, on the death of the Duke of Chandos; when Dr. Milles, Dean of Exeter (whose uncle had considerable property in Ireland), purchased a large portion, and deposited them in the British Museum, where they are now known as the "*Clarendon Collection.*" Dr. Rawlinson bought others, and bequeathed them to St. John's College, Oxford, whence they were subsequently transferred to the Bodleian Library; and some part fell into the hands of Lord Newport, Lord Chancellor of Ireland, and the remainder were widely scattered, and no trace remained of them.

A Catalogue of Ware's MSS. was published in Dublin, in 1648, of which, I believe, there is but *one copy* known to exist, and *that* is in the Bodleian Library; but, as it was published before Ware's acquaintance with Mc Firbis, it of course contains little information regarding the productions of the latter.

As Lord Clarendon's property, a Catalogue of the MSS. appears at the end of the "Catal. Codd. MSS. Angli et Hib., Oxon, 1697;" and the Duke of Chandos' Sale Catalogue, 1746, affords a reasonably accurate description of the collection.

Having premised thus much as to the fate of the Tracts under consideration from the date of their purchase by Lord Clarendon until they were deposited in the Bodleian Library, I now invite the attention of the Academy to the *Tracts themselves.*

No. I.—The First Tract,

to which is prefixed an Invocation of Jesus, Mary, Patrick, Columcille, Bridget, and the Holy Trinity, is entitled,

"The Authors of Erin, with an Account of their Authorship, and their Paternity, are arranged here by Dubhaltagh son of Giolla-Josa Mór Mac Firbisigh of Leacan, in Tir Frachrach of the Moy. 1656."

No. II.—The Second Tract,

to which the same Invocations are prefixed, is entitled,

"An Aid to Remembrance, here, regarding certain Bishops of Erinn, who are not now reckoned as having filld Bishops Sees, Tho' they were so accounted, in their own Sees and Times. Understand Reader the *Sees* are mentioned *first*, and the *Bishops* afterwards.

"I am Dubhaltach Mac Firbisigh who arranges this 17th March, Anno Christi, 1665 or 1666."

Although, strangely enough, the name of Duald Mc Firbis is not even mentioned in O'Reilly's "Account of Irish Writers," it was known that he had compiled "A Treatise on Authors." And the late lamented John O'Donovan and Eugene O'Curry, when deploring *the loss of this Tract*, only echoed the sentiments which our venerated Academician, Dr. Petrie, had on more than one occasion given expression to. Mac Firbis himself, in the preface to his great genealogical work, refers to such a compilation, when, speaking of the various ancient authors, he says:—" Why should I be enumerating them, for they cannot be counted without writing a large book of their names,. . . And, not to give but the *Titles alone* of the Tracts which they wrote, *as we have done before now*." (See Curry's "Lectures," p. 218.) But this preface was written in the year 1650, whereas the original of the Tract before us was compiled or transcribed by the compiler from an earlier copy, in the year 1656, old style.

This Tract is, I regret to say, defective; it is Mr. Hennessy's opinion that *it was never finished;* and, as exhibiting his reasons for coming to this conclusion in opposition to Mc Firbis's statement just referred to, I may quote a letter received from him, accompanying this donation:—

" Dear Sir—During a recent examination of the Irish MS. collection preserved in the Bodleian Library, I had the good fortune to discover two original Tracts in the handwriting of Duald Mac Firbis, which somehow escaped the keen research of the late Dr. O'Donovan.

" Having accomplished the laborious task which I had proposed to myself of making a transcript of the profusely gloss'd copy of the Festiology of Ængus, preserved in a MS. of the twelfth century in the *Laud Collection*, I made as close an examination as my limited time permitted of the very rare and inestimable MSS. preserved in both the Laud and Rawlinson Collections. On looking over the small paper volume 'No. 480, Rawlinson,' I recognised the, to me, well known handwriting of Mac Firbis. The MS. consists principally of Ecclesiastical Tracts, one of which, comprising 11 folios, is thus entitled:—

" 'Here beginneth the Booke of St. Patritius the Bishoppe, entreating of the Joyes of Heaven and the Paines of Hell, and of the goodness and evilnesse of this world.'

" And at the end—'Here Endeth the Booke of St. Patricke the Bishoppe, translated out of Lattin into English by R. S., 1585.'

" And the translator adds—' Vide ye Booke calld ' Pricke of the ye conscience upon the same subject more at large.'

" The portion in Mac Firbis's handwriting consists of only fourteen folios, but closely written, and the handwriting being very minute, and so beautiful as to excite surprise, when it is remembered that the writer was nearly seventy years of age at the time.

" The first eight folios contain a part of his '*Lost Treatise on Irish Authors*,' and the remaining six contain a curious '*Tract on Ancient Irish Bishops and Bishopricks*,' not accounted as such in Mac Firbis's time.

" At the end of every page of the first of these, the Treatise on Authors, except the last, the letter or word with which the succeeding page commences is uniformly added; and the omission of this mark of continuation from the last page is, I am inclined to think, a proof that the author never completed the task which he had set before himself. And I may also observe that in some places the memorandum, 'see page,' occurs, the No. of the page not being entered, as it would doubtless have been had the Treatise been completed.

"It is within the range of possibility that he intended in this Tract to expand the Catalogue of Authors, which he states in the preface to his Genealogies he had compiled, but the execution of this project was cut short by some cause or other which we are unacquainted with. At all events, of both these Tracts, such as they are, I have made accurate transcripts, and I venture to confide them to your care for presentation to the Royal Irish Academy. And I beg to add, should the Academy deem them worthy of publication in its 'Transactions,' that I will cheerfully undertake the duty of translating and preparing these Tracts for the press.

"I am, dear Sir, yours faithfully,
"W. Hennessy."

"*To D. E. Kelly, Esq.*"

Now for the Tracts themselves.

No. I.

This has the words "De Scriptoribus Hibernicis" written on the upper margin of the first page, in a handwriting very much resembling Sir James Ware's; and some words are also glossed in the same handwriting. But Sir James was certainly not sufficiently versed in the Irish language to have been able to interpret the words explained. The author begins by advancing the usual arguments put forward by the critics of his age respecting the antiquity of the Scotic, i. e. the Irish language; after which he enumerates the principal professors of knowledge who accompanied the several immigrations into Ireland from Fintaun, who came with Cesara before the Flood! to Amergin, the son of Milesius; and, coming down to later times, he adds some names to the list of families which furnished hereditary Professors of the several branches of Poetry, Law, Medicine, and History.

In the department of Senchas, or History, for example, he enumerates the following families, in addition to those already known, viz.:—

The O'Flyns,
The O'Dunns,
The O'Quills, and
The O'Squinins.

The principal hereditary Professors of Law he states to have been—

The Clann Aodhagan, or *Egan*;
The Siol Flachadha, or *M'Clanchys*;
The Clann an Brethemhain;
The O'Breslens;
The O'Dorans; and
The O'Haras.

The Ollamhs of *Aes Dana*, or Professors of Poetry, he states belonged chiefly to the following families:—

O'Dalys,
O'Donnellans,
O'Higgins,
Mac a Wards,
O'Hancairty,
Mac Convey,
O'Hussey,
O'Rooney,
O'Coffey,
O'Gearan,
O'Cloomhan,
O'Cronga,
Mac Graith,
O'Cillen,
O'Moran,
M'Casserly,
O'Phelan,
O'Heffernan,
Mac Keogh,
O'Hayden,
O'Gneev,
O'Lorcan,
Mac Murray,
and many others.

And amongst the Professors of the Art of Healing he mentions, in addition to those enumerated in Sir William R. Wilde's learned Essay, prefixed to the Table of Deaths, "Census Report," 1851, the names of

Mac Neagh, qr. Mac Niaḋ,
Clann Multeely,
O'Fennelly,
O'Ronan,
O'Feely,
O'Cuhin,
O'Meledy,
O'Connell,
O'Leyne,
O'Beglan,
Clan an Deasy,
Mac Gilmartin,
O'Heneys,
&c., &c.

Then the author proceeds to describe the nature of the writen remains of Irish literature, and observes that the knowledge of Feneachas or the laws was confined to three or four sons of the Ollamh of Connaught, including himself, I presume.

"Woe is me!" he says, "the little regard Erin has for the preservation of knowledge or superiority."

The subject of the formation and development of the Celtic language under Feninsa Farsaidh and his disciples, and the invention of the Ogham alphabet, is discussed in detail, and with much ingenuity of argument. This chapter is illustrated by a sketch of what he calls *the most usual Ogham character*, corresponding with the third alphabet in the "Book of Ballymote," except that M'Firbis has by mistake *omitted the vowel signs*. At page 7 of the original text, but page 28 of the present volume, reference is made to a volume of laws, called Eḋġeḋ (Edghedh), attributed to Luigne mc Eremhon, of which I am not aware that any fragments have been preserved.

The treatise ends with a notice of the celebrated Naente Nac-Brethach, or "of the 9 judgements," who is alleged to have lived 200 years before the Christian era; and although this notice is unfortunately incomplete, it is curious, as attributing to *him* the famous judgment of "*To every cow belongs its calf*," which is asserted to have been appreciation of which it is necessary to go a little into detail, as regards the circumstances of the group formed by this impost, and the remains immediately connected with it. I cannot better describe its general appearance than in the language of Stukeley, premising merely that his "altar" designates a fallen block of longer and more slender proportions than the impost containing the mortises, which lies flat on the ground, pressed down by the weight of the fallen impost lying across it near one end, and of the fallen pillar also lying across it near the other. "The *trilithon* of the upper end of the *adytum*," says Stukeley, "was an extraordinary beauty. But, alas! through the indiscretion probably of somebody digging there between them and the altar, the noble impost is dislodged from its airy seat, and fallen upon the altar, where its huge bulk lies unfractured.

> '*Decidit in solidam, longo post tempore, terram*
> *Pondus, et exhibuit junctam cum viribus artem.*'
> Ovid. *Met.*

"The two uprights that supported it are the most delicate stones of the whole work. They are, I believe, above thirty foot long, and well chisell'd, finely taper'd, and proportion'd in their dimensions. That southward is broke in two, lying upon the altar. The other still stands entire, but leans on one of the stones of the inward oval.

> '*Jam jam lapsura, cadentique*
> *Imminet assimilis.*——.'"

The fall of this trilithon took place about 1620. The impost about which this inquiry is chiefly concerned is stated to have originally measured sixteen feet; but owing, no doubt, to the injuries it has sustained by the destructive curiosity of visitors, it is now reduced to fifteen feet some inches or thereabouts, for the corrosions and irregularities of its surface, and the shattered condition of its ends, render an accurate measurement somewhat difficult, and only to be accomplished by the aid of appliances which would reduce its bevelled and irregular outlines to the square. It lies on edge, presenting the flat of what was its under surface to the east. This face has suffered comparatively little; but time and the weather have made great ravages on the western or upper face. The lower edge on which it rests is straight; the upper edge somewhat convex, indicating that this latter lay towards the outside when *in situ*, for such is the arrangement of the two adjoining trilithons which are still standing. The mortises on the under surface are eight feet six inches apart from inner, and twelve feet two inches apart from outer, edge to edge, and are unequal both in area and depth. That towards the southern end, which formerly locked on the tenon of the leaning pillar, is an oval bowl, twenty-five inches in its greater by seventeen inches in its lesser diameter, and seventeen inches deep; that towards the northern end, which locked on the tenon of the fallen pillar, is an oval bowl, nineteen inches in its greater by thirteen in its lesser diameter, and ten inches deep,—being, however, much abraded and reduced in depth on its outer edge towards the northern extremity of the impost.

The cavities, about which I am more immediately concerned, on the western or upper face, are nine feet six inches apart from inner, and eleven feet seven inches apart from outer, edge to edge. They are of irregular circular form. That towards the southern end of the impost is a dish-shaped indentation, thirteen inches in its greater by twelve inches in its lesser diameter, and 3½ inches deep. That towards the northern end is a dish-shaped indentation, twelve inches in its greater by ten inches in its lesser diameter, and four inches deep. The major diameters of these hollows lie in the direction of the length of the impost. The lips of the upper cavities are worn into irregular indentations; and hollows of from eight to ten inches in breadth, and about two inches in depth, extend from both to a distance of more than a foot. It is not impossible that the same process of erosion may have obliterated tool marks, if such existed within the cavities. The tool marks have in fact disappeared from the surfaces both of the squared leaning pillar and of its supporting leaning obelisk, which is grooved in the direction of its length, although plainly visible on the tops of the fallen pillars on the right, where they have been picked down into smooth surfaces for the bedding of their imposts. Then it must be owned to be extremely improbable that chance corrosions should have resulted in the formation of cavities so nearly symmetrical with the opposite mortises.

This impost and the fallen pillar cover about nine feet of the exposed surface of what has been called the "altar stone." Where its ends appears from under these incumbent masses, they are reduced in thickness by the breaking off of portions of the exposed surface; so that, partly owing to this cause, and partly to the obstruction of the ruins above, it is impossible, in the present situation of things, to say whether indentations corresponding to the cavities in question existed or exist on this stone also; but its dimensions and position are such, that if an upper trilithon ever stood over the central impost, this stone was probably the lintel of it; and if, further, the recognised derivation of Stonehenge be correct, this probably was the object which gave to the monument its patibulary designation of "Stone Gallows." It is just sixteen feet in length by three feet four inches broad, and it is stated by Stukeley to be twenty inches thick. It has been surmised to be an altar, and a table of astronomic observation; and some reliance has been placed on its position, as seen on the ground plans of the place, being symmetrical with the surrounding objects: but its position, in fact, is considerably off the line of theory, and is not symmetrical with any line of construction, but is such as a heavy stone tumbled from above the central trilithon might take in its fall, especially if its fall were occasioned by the tilting over of upright supports; and in such case the height of the supports would probably be about the measure of the distance to which their fall would cast the lintel resting on them. It lies north-east by south-west, at a distance of about ten feet from the foot of the central trilithon, and nearly but not quite parallel to its inner face, as it originally stood.

Supposing such a superstructure to have existed, it may be asked what bearing would that fact have on the question of the age or uses of the monument? I shall venture no further in speculation than to observe, that the gateway erected over the gateway is a form of commemorative monument in the East, and that if anything in the construction of Stonehenge looked to an Eastern model, it would probably turn the scale which has lately hung in pretty even balance between a post-Roman and a pre-Celtic date for its erection. A remarkable example of the Eastern form of monument may be seen in "Fergusson's Picturesque Illustrations of Indian Architecture," where the details are given of a structure of this kind, of three stories, forming part of the *enceinte* of a sepulchral tope at Sanchee, near Billah, in Central India. The rest of the enclosure is composed of stone pillars carrying a continuous impost, and so much in the Stonehenge taste, that the writer (p. 22) queries, "Are these the originals of the trilithons of Stonehenge?" The same species of monuments occur in variously modified forms throughout Tartary and the remote East. Several examples may be seen under the head "Pailoos," in the "Handbook of Architecture" by the same writer (pp. 137 *et seq.*).

A sculptured object, ten inches in length, observed by Dr. Tate in 1861, which attracted the attention of the British Association at their Bath meeting in September, 1864, exists about midway between the mortises on the under surface of the fallen impost. It is nearly symmetrical with the lines of the stone, six inches nearer the southern mortise, and leans towards the south. It consists of a straight upright line, broadly hollowed out, and with an appearance of antiquity, having at top a curve similar to a reaping-hook, or a Roman letter ɔ reversed, and below a smaller curve of the same character turned the opposite way. The curved portions of the sculpture appear to be sharply incised, having an angular section and a modern aspect; but they also bear the appearance of having been hacked and gone over recently with some tool, so that there is a difficulty in saying that the whole may not be ancient. It bears a generic resemblance to an object sculptured on one of the stones of the sepulchral chambers of the *Butte* of Tumiac in the Morbihan. The letters LV inscribed within the upper curve appear to be modern.

The tendency of recent explorations is to throw back the period of monuments of this class. The possibility that an examination of the lower surface of the so-called "altar stone" at Stonehenge might disclose some constructive or other traces calculated to explain the language of Henry, induces me to observe, that the pressure both of the impost and fallen pillar could readily be removed by a simple mechanical appliance without the slightest disturbance to the rest of the fabric.

Annexed is a list of the works which have been examined with a view to see how far the evidence of Henry of Huntingdon has been regarded.

"Camden's Britannia." By Gibson.

"The Most Notable Antiquity of Great Britain, Stonehenge, Restored, by Inigo Jones:" 1655.

"Chorea Gigantum, or the most Famous Antiquity of Great Britain, Stonehenge, Restored to the Danes;" By Walter Charlton: 1663.

"Stonehenge, a Temple, restored to the British Druids." By William Stukeley, M.D.: 1740.

Keysler, "Antiquitates Septentrionales."

King, "Monumenta Antiqua Britanniæ:" 1799. Vol. i., pp. 188, *et seq.*

"Ancient Universal History:" 1746. Vol. xviii., pp. 430 *et seq.*

"History of Wiltshire." By Sir Richard Colt Hoare, including the Restorations of Waltire, Smith, and Account of Stonehenge by a Gentleman of Salisbury.

"The Celtic Druids." By Godfrey Higgins: 1827.

"Cyclops Christianus." By the Hon. Algernon Herbert: 1849.

Articles "Stonehenge" and "Wiltshire" in "Encyclopædia Britannica," Edition of 1860.

Article "Stonehenge," in "Quarterly Review," July, 1860.

"An Illustration of Stonehenge and Abury," by H. Browne: 1864.

"Gentleman's Magazine," December, 1864, Article "Bath Meeting of the British Association."

Captain Meadows Taylor read a paper, "On a Group of Ancient Cairns on Twizell Moor, in Northumberland."

Professor W. K. Sullivan read a paper "On the Composition and Mode of Formation of a peculiar Hydrated Mineral containing Zinc, and on the Formation of the Halloysites found associated with Zinc Ores."

The Secretary announced a donation by Charles W. Levinge, Esq., of Levington Park, of the remains of an ancient oak canoe, found in Owel, Co. Westmeath.

The marked thanks of the Academy were voted to the donor.

MONDAY, JANUARY 23, 1865.

William Henry Hardinge, Esq., in the Chair.

Mr. John Locke, A. B., by permission of the Academy, read the following paper:—

On the Antiquity of Man.

"Wast thou born before Adam?"—Job, xv. 7 (*Heath's Translation*).

Certain writers assume a gradational progress from a natural condition of savagery to the ascendant intellect of the nineteenth century,—referring the aboriginal human animal, with his imperfect appliances of stone, horn, wood, and bone, to an indefinitely remote, *because* unchronicled era; but neither history nor experience furnishes tangible or reliable evidence in support of such an equably continuous developement, unbroken by retrogression and revolution. Declension from a state of comparative civilization to barbarism seems, indeed, cumulatively rapid; but of the converse—spontaneous progression *ab infra*, from savagery to civilization, apart from introduction of extern aid, or special supplement of Christian culture—we have no authenticated example. In fact, the theorist in archæology frames, however unconsciously, his own introspective notion of time as measured by an arbitrary sequence of developement in uniformly advancing series, and applies this imaginary rule unconformably to the past,* as if time itself were the generative cause, and not a mere passive condition of entities and events. He cannot legitimately summon geology to his aid in propounding the pre-Adamite existence of man, until experts in that science have welded geological to secular duration (if that shall ever be accomplished), by modifying the stratagraphical classification, intercashould recede into chaotic gloom, many millenniums beyond the genesis of Mosaical chronology.

Again—Applying the observed numerical statistics of succession and increase to the antiquity of man, the solution will be found to confirm the Mosaical period of 6000 years since the creation of Adam. Exceed that period by even a small proportion of the hundreds of millenniums assigned by some to the past duration of our race, and then, making amplest allowances for all the checks to fecundity, inevitable, or fortuitous—war, famine, pestilence, death by physical accident, or by natural decay, and all the other ills entailed by sin and violence—nevertheless, man must have multiplied up to this date to such an extent as to render collective existence impossible within his present circumscribed domain, except the cumulative pressure of population was stemmed by a universal cannibalism, or a wholesale exodus at stated periods to some other planet was found practicable. To such monstrous and absurd conclusions are those driven, who reject the evidence of revelation, history, and experience, for the wild inventions of an unchastened imagination.

The frequent occurrence of stone implements, unassociated with organic human remains, is obviously accounted for by their superior specific gravity to the soils on which they were originally deposited, and consequently their gradual yet persistent descent to the glacial or fluviatile drifts; while the lighter organic remains mingled in decay with the superficial mould. Aqueous infiltration, cuspidal form of the descending fragments, pressure of superinduced material, and the reciprocal effects of weight and adhesiveness, would all modify the rate of subsidence according to the comparative conditions in each instance; but down they go as surely as lead sinks in water; while the flying dust above, and that curious vegetable chemistry which abstracts carbon from the atmosphere, gradually increase the depth by continuous increments of surface covering. Had the late distinguished Chevalier Bunsen given due consideration to this simple fact, when he exhumed a few potsherds from the riparian silts of the Nile, it would have saved him the unprofitable toil of elaborating a chronology rivalling in extravagance the Egyptian myth of the pre-Adamite kings.

Again, where stone implements are found commingled with bones of animals, that had been subsequently delocalized by migration induced from climatic change—or of those extinct gigantic Pachyderms, of which the sole surviving link is the Auroch of the marshy forests of Lithuania* and the Caucasus—the state of organic preservation even of the most decayed remains does not warrant a remoter origin than the Noachic deluge, to which their miscellaneous grouping might be naturally referred. To adduce the most familiar example, the *Cervus megaceros* must have been living in Ireland at a period long subsequent to the Celtic and Iberian invasions, when the remnant of the subjugated natives, driven into the forests and peat moors of the interior, utterly perished with extinction of those animals that constituted their chief means of subsistence; for the skeletons are most commonly found imbedded in the lacustrine marl or calcareous tuff beneath the peat, and often contain much organic material. A centesimal analysis of a portion of one skeleton by Professor W. Stokes yielded 43·45 phosphates, with fluates, and 42·87 animal matter; and Professor Apjohn, after a careful chemical examination, states that "the cartilage and gelatine had not even been perceptibly altered by time" (Hart on "Fossil Deer of Ireland," p. 22–3). The Megaceros, therefore, must necessarily have been a contemporary of man far on in the historic ages; although from Herodotus to Cæsar, and thence to Oppian, there is no specific mention of this most magnificent of the ancient giant Pachyderms; nor even by native annalists, save a solitary and dateless tradition of the whole species having been swept away in one season by a destructive murrain.

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* It is impossible from the delineations of Ptolemy and other early geographers to define with any approach to accuracy the topography and extent of ancient regions and populations; and we shall probably find in Cæsar more reliable information respecting northern Europe than in any previous writer. From him we learn that the Hercynia Silva, a mingled wilderness of forest, mountain, and marsh, extending for sixty days' journey from the Upper Danube towards the Baltic, was then unexplored; and

The present or human geological era does not display the phenomena of new creations, but is distinctively characterized as well by the gradual decay and disappearance of those species least ministering to the necessities and uses of dominant man, as by the progressive melioration and sporadic increase of all the animals specially adapted to his service, comforts, and æsthetic choice; and this law extends also to the

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that from its remote recesses occasionally issued huge beasts of strange form and fierce nature. The information is acknowledged to be only from hearsay, and bears the impress of exaggeration; but he describes at least one animal, which we can identify with occasional displacement of indigenous Floras by introduced plants of a more utilitarian character.[*] Indeed, exaltation of type seems the one essential condition of continuity even with nature's grandest pattern, man; for, wherever improvement is arrested or undeveloped, extinction impends; and barbaric tribes either die out "without hand" in presence of their ascendant brethren, or the debasing characteristics are effaced in course of a few generations by assimilating intermixture with immigrant civilized communities.

According to the testimony of Pentateuchal history, happily as yet unshaken by "the controversies of a counterfeit science,"[†] civilization was the primitive condition of man. The metallurgy of "brass (bronze), and iron," was known even within the Adamic epoch,[‡] and consequently must have been transmitted to post-diluvian ages by Noah and his family; for the ambitious attempt at centralization in the plain of Shinar betokened cultivated acquaintance with the constructive arts; nor does there appear any warrant of disproof that the primitive fabricators of stone, bone, and horn implements were but outcast remnants of that "one people," which, under the constraint of Divine appointment, had "been scattered abroad upon the face of all the earth,"[§] whose moral degeneracy precipitated their physical deterioration, until, becoming feeble and timid, they were pitilessly driven by subsequent immigrations of more powerful tribes into rocky deserts and forest fastnesses, without the means and appliances of civilized life. Job,[‖] fifteen hundred years before Christ, gives a graphic description of a certain Pariah race[¶] who had probably been ejected from their primeval seats by the warlike princes of the Ishmaelites and the fierce and restless dukes of Edom; and it is curious to observe how accurately this passage in the book of Job accords with the account of the Troglodytes a thousand years after his time by Herodotus.[**]

Certainly the 730 years intervening between Babel and the Patriarchal era of Job afforded ample interval for the rise and decadence of numerous peoples, whose existence the Mosaical history of the chosen nation notices only by the brief record of a name, and who had been swept away by the devastating sword of successive revolutions, as diversified and destructive in their effects as those physical changes produced by the fiery deluge that overwhelmed the cities of the plain. Migration on a world-wide scale prevailed even during the Noachic age. Thus Cush, the grandson of Noah, is described by Sanchoniathon[*] as a colonizing monarch, traversing the earth; and these waves of population surging from the Mesopotamian plains, and again in subsequent ages refluent upon their former tracks, would inevitably tend to create certain residual and stagnant eddies (as it were) of the primitive settlers in all the intermediate regions.

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[*] See an interesting account of displacement of certain indigenous plants of New Zealand by intrusion of European grasses and weeds, in a letter to Dr. Hooker from an accomplished naturalist, W. T. Locke Travers, F. L. S., &c., in "Natural History Review" for October, 1864.

[†] 1 Tim. iv. 16—see original.

[‡] Gen. iv. 22.—The earliest notice after the Deluge of the mining and smelting of metals is found in Job, xxviii. 1-11, describing, in sublime poetic language, hydraulic and other operations of mining on the grandest scale.

[§] Gen. xi. 8. [‖] Job. xxx. 1-11.

[¶] The Sukkiim (סֻכִּיִּים, 2 Chron. xii. 3), who swelled the invading host of Shishak, is rendered in the Septuagint, *τρωγοδύται* (? *τρωγλοδύται*), and in the Vulgate, Troglodytæ—manifestly an incorrect rendering in both versions. The Hebrew word signifies "dwellers in tents, or booths" (not caves), and probably designated a warlike nomadic tribe of Ishmaelite descent. The abject and feeble Pariahs would have been an incumbrance, rather than an efficient auxiliary to an army numbering 12,000 chariots and 60,000 horsemen, besides footmen "without number."

[**] Melpomene, sect. 184.

The unhewn megalithic structures,[†] scattered over all lands from farthest East to remotest West, furnish a "testimony of the rocks," more enduring and significant than any extant historic record, of the invading as contradistinguished from the primitive colonizing migrations. The Menhir of Brittany and the Irish Gallaun are but Gentile analogues of the pillar set up by the Patriarch at Bethel.[‡] Now, these Oriental outswarmings succeeded each other at irregular intervals, and over unequal extents, until the commencement of authentic Greek and Roman annals, when Scythian, Scandinavian, and other Northern hordes rolled back the tide, combining in their turn to produce similar debasing effects among those settled populations, that had in former ages migrated from the East. Indeed, civilization and savagery appear in contemporary contrast in every era and in every clime, and the phenomenon of a decivilized people, dwarfed alike in mind and body, is not the peculiar characteristic of any one country or dispensation. In Europe, although the Pariah tribes have disappeared, except perhaps in the instance of the Cagots of the Pyrenees, yet their former existence in great numbers is clearly inferred from the vast quantities of stone implements and other rude remains strewn upon the diluvial gravels, or exhumed from ancient shell heaps, pile dwellings, and ossiferous caves, or swallow holes; and elsewhere throughout the world, especially among the low castes and hill tribes of India, in the central forests and sundry remote islands of the Pacific Archipelagos, in the Fuegian peninsula, and in the interior of Africa, where Strabo* found the descendants of those cave dwellers described by Herodotus 500 years before, remnants of degenerate and outcast races survive to this day; and traditional myths of their archaic derival and primitive social condition are extant in the literature of the more powerful immigrant tribes, who drove them from their aboriginal seats into forests and solitary places; but among the lapsed races themselves not a trace of history or tradition has been discovered, on which to base even a proximate conjecture of their origin in circumstance or in time.

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[*] Eusebius, l. i.

[†] In the Pentateuchal histories these unhewn structures, monolith, trilith, or of more complicated form, are described as set up for various purposes—altars, sepulchres, boundaries, testimonials of triumphs, covenants, deliverances; but when the purity of Patriarchal Theism was polluted by idolatrous admixture, so that the symbol itself came to be worshipped, injunctions were issued under the Law and the Prophets to destroy utterly all such monuments. The command, however, was but partially obeyed until the return from the Captivity, from which period to the close of the brief Asmonean dynasty the iconoclastic ardour of the chosen race left scarcely a vestige of the numerous megaliths that once marked with their uncouth figures all the Syrian hills and plains. In other regions, especially of Northern Europe, where the earlier Oriental colonists had erected Cyclopean structures after their ancestral fashion, no such styloclastic zeal was evinced; and even upon the introduction of Christian missions these rude memorials were not only preserved intact, but it was sought to evangelize the stolid and superstitious idolaters by grafting pious figments on what seems to have been the earliest and most debased phase of a material idolatry; for the primitive graven image is not described in the Bible as essentially distinct from the stone pillar (see Deuteronomy, vii. 5, and marginal references, in the original).—In the Celtic languages the word for idol, which is usually applied to the rude monolith, is exactly like the Hebrew word both in etymology and sound. For example:—The Irish word Ioṁaıġ (Eevau), and the Hebrew, אָוֶן (Eevan), both signify *idolum, vanitas, nihilum*; and thus St. Paul's definition receives an expressive confirmation (1 Cor. viii. 4) where he terms an idol *οὐδὲν ἐν κόσμῳ*—"nothing in the world"—a vain semblance of that which has no existence. See some curious notices on this subject by the writer in "Belfast Archæological Journal" for October, 1853, p. 303; and "Notes and Queries," 1853, p. 413; and second series, No. 62, p. 194; together with the Articles referred to therein.

[‡] Gen. xxviii. 18.

In Australia at the present period we observe on a continental scale the contemporaneity of an intruded civilization with the phenomena of what archæologists term the Stone era; nevertheless the latter possesses no chronological significance whatever; and scientific theorists may well pause and ponder, ere they construct an imaginary series of gradational progress from an unchronicled antiquity, when they contemplate the myriads of these Papuan savages, with flint weapons and prognathous aspect, in contact with an unparticipated civilization, uncheered by the presence and unimpressed by the example (save as to debasing influences) of the superior race; and these contrasted conditions, too, exhibited in association with an indigenous Flora and Fauna, characteristic of an era indefinitely withdrawn in the succession of geologic time. In absence of sufficient proof of extreme antiquity, *non-historic* or *unhistoric* would be a more appropriate term for the Cave-men and Lake-dwellers than *prehistoric*, in reference to the question of chronology.—Mystery ever attaches to the unknown; and where the darkness of oblivion rests upon the pristine homes and habits of a vanished people, imagination busily fashions into long periods the unrecorded past. It may also be observed, that this negation of the historic elements does not *necessarily* imply a state of savagery. We infer the civilization of the Aztecs and Etruscans respectively from elaborate sculptures and mortuary memorials, or domestic utensils of elegant design; yet these, like the fossil organisms of the rocks, supply no key of historic interpretation, and the inscriptions are in a language utterly lost; so that no intelligible record survives of the annals, origin, or social condition of these highly cultured peoples, nor yet of their more famous predecessors, if not indeed founders, the Phœnicians, who for more than 1500 years after the dispersion from Shinar unceasingly extended their arts, religion, and literature, to all shores accessible by their enterprise and commerce. The testimony of a Roman historian may here be aptly introduced in illustration. The populous state of the Veientes, renowned and powerful long before Rome was founded ("Civitas antiquissima Italiæ atque ditissima," Eutropius, l. i., s. 19), had been utterly destroyed by the arms of the advancing Republic, 399 B. C.; and Florus, only 500 years after, in the reign of Trajan, thus apostrophizes the Veientes—"Fuisse quis meminit? Quæ reliquiæ, quodve vestigium? Laborat annalium fides, ut Veios fuisse credamus."* Within the short space of five centuries, and in a comparatively civilized era, oblivion had swept away every vestige of this renowned Etruscan people, so that even their former existence seemed dubious, and their magnificent cities, like Veii, as if they never had been.

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* l. i. and xvi.

As for the guesses of those sciolists, who, regardless of the Divine afflatus which constituted man "a living soul" (Gen. ii. 7), if not likewise of his distinctive organic structure, have invented the priscan, *alias pithecoid* man, for the purpose of demonstrating the pre-Adamite antiquity of the human family—pronouncing a solitary exceptional instance of an abnormal skull (it may be idiot or cretin) to be the type of a species, and thus rounding off the transmutation series from Mollusc to Man at the superior end—now, in Australia, if anywhere, the missing link might be confidently sought; for there the aboriginal Papuan presents the most debased form of the human organism; yet it so happens that the Simiæ are not found, either indigenous or fossil, the Fauna of that region indicating a geologic era many thousand years anterior to their appearance on our globe. It is difficult to believe that Anthropologists are really in earnest in propounding this strange theory; however, there is no accounting for tastes, and the pride of ancient ancestry sometimes assumes an amusing perversion. The Simian advocates may easily test the conditions of their fantastic thesis by organizing an expedition to the banks of the Gaboon,

> "Where wild in woods the noble savage *runs*,"

not for the purpose of skinning their hirsute cousins, like Hanno, or du Chaillu, but of introducing social reform, and educating them up to their own standard of rational accountability. Doubtless the civilized Orsons of Gorilla Land would hereafter move respectably on all-fours in *anthropomorphological* circles, and in due time be enabled to enlighten their scientific patrons and the public on the genealogy and habits of *pithecoid* or priscan man.

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* l. i. c. 12.

The Museum at Bern presents probably the most complete collection of primitive rude implements of human manufacture, discovered in the ancient lake dwellings of Switzerland (in Ireland termed Crannogues), where these had been exposed by an unusual subsidence of the water levels; the cushion of still water beneath the frozen or wind-moved surface having preserved from oxygenating waste and atmospheric wear and tear numerous relics of what are assumed to be successive stages of well-defined progress from an aboriginal savagery to civilization; although, indeed, these may have existed contemporaneously under diversified conditions of isolation and physical privation. However, admitting the succession of epochs, they may be consistently included within the historic period of Helvetia, as known to the Greeks and Romans, from the pre-Christian irruptions of the Teutones and Cimbri to the Gothic and Frankish invasions of the Gallo-Roman era. During this stormy interval of 700 years the central highlands of southern Europe, situate as it were in the very axis of revolutionary transit, sustained the convergent pressure of warlike and antagonistic races. The Romans unceasingly pressed upward from the south along the Alpine streams and passes; while barbarian hordes successively, or in confederate bands, overflowed from north, west, and east, tracing their devious paths by the great fluvial highways of those forest-covered regions, along the courses of the Rhine, and Upper Rhone, and through the valley of the Inn from the vast and populous basin of the Danube. Thus the Helvetians (both aboriginal or descended from the primitive replenishers* of that region, as well as those of mixed colonial blood of Etruria and Rome) were swept by every recurrent wave of invasion from their cities and settlements in the fertile intra-Alpine vales into the inhospitable mountain districts; again driving before them with unsympathizing rigour, into fastnesses still more remote, the Pagani, or less civilized populations on the outskirts of their respective territories. Mercy for the feeble is the attribute only of a long-sustained moral and intellectual culture; and these despised outcasts, hated for their very harmlessness, and rifled of their weapons and all appliances of industrial acquisition or improvement, hid themselves in solitary caves of the rocks, or constructed in unexplored localities rude insular dwellings as a frail nocturnal protection against wild beasts, with whom they waged a dubious strife in the struggle for existence. Fear on their part, with aversion on the part of their enemies, would tend to continue, as well as aggravate, this compulsory exclusion from all advantages of civilization; thus stereotyping, as it were, the superinduced savage state, by closing every avenue to functional developement of mind and body. No diligent student of human nature will deny that a persecuted and inopt race,† under incessant endurance of hunger, cold, and terror, must even within the lapse of three or four generations become almost hopelessly deteriorated both intellectually and physically, losing, together with the intenser vitality of soul, all memory of the history, arts, and social condition of their progenitors—no desire, save the satisfaction of instant animal wants—no audit of time beyond the changing season, or the passing day; for time must be a pure negation to those who are incapable of applying thereto the measure of ideas and incidents in intellectual progression.—Alike unheeded as unchronicled by their oppressors, thus existed and passed away, thus now survive, yet decaying before our eyes, the degenerated tribes of the human species.[*]

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* Gen. x. 5.

† Distinction must be made between these timid and proscribed Pariahs and the early colonists of high latitudes, whose very climatal disadvantages kept them apart alike from the improvements and obstructions of a dominant civilization. There is every

It is submitted that, conceding their due value and significance to the discoveries of geologists and archæologists, the phenomena adduced up to this date do not afford adequate evidence in demonstration of the universality of the (so-termed) Stone era, or that it preceded civilization upon our globe; and both sacred and secular history accord with human experience in authenticating, first, the Mosaical limit of 6000 years since the creation of man; secondly, that civilization, not savagery, was his primitive condition; and, thirdly, his utter incapabilityof self-renovation from moral and physical decadence, apart from extern aid and instruction.

From the days of Adam even to the ascendant enlightenment of this nineteenth century of the Christian dispensation, civilization and

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probability that a thousand years before the Christian era, and therefore strictly within the domain of secular history, icebergs not only stranded on the coasts of the Baltic and North Seas, but were launched even from glaciers formed in the maritime glens of Wales and Scotland; and that in the littoral regions of the British Isles, Denmark, and Northern Germany, dwelt many scattered tribes, of whom we have obscure intimations in the earlier semi-fabulous annals, as being clad in the skins of animals slain by their rude primitive weapons, and dwelling amid ice and snow, like the Esquimaux of our age. This view receives accidental confirmation from the bones of the *Alca impennis* (great Auk) having been lately discovered in shell mounds in Caithness, which would imply a sub-arctic climate in Scotland during the so-termed Stone era, when feeble communities of men dwelt in isolated localities along the coasts, and giant animals (now extinct) roamed undisturbed through the marshy plains and forests of the interior.

That climatic improvement may be effected to a considerable extent, independently of physical revolutions, by the slow yet persistent agency of man, in felling forests, draining marine and lacustrine marshes, and confining rivers within their courses, is exemplified (to quote but one instance) in the elevated mean temperature of the New England states within the two centuries and half since the "Mayflower" touched the American shore: how much more, then, must the climate of Northern Europe have been improved under similar agencies for well nigh twenty centuries!

[*] The "Hobart Town Mercury" of 20th October, 1864, states that the only survivors of the Tasmanian aborigines then in existence were one man and three women; "the latter not being of such an age or appearance as to justify the expectation of any future addition to their number;" so that the whole race may now be deemed extinct within the brief period of sixty years, notwithstanding humane exertions to preserve the remnant. See papers on "Discoveries in Australia," in the "Dublin Quarterly Journal of Science," for 1861, '62, and '63.

savagery have dwelt together upon the earth, associated, although in contrasted aspects; and their continuance, without coalescing, awaits the solution of the providential, not *geologic* future.

MONDAY, FEBRUARY 13, 1865.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The Rev. Charles P. Meehan; William Mansell Hennessy, Esq.; and T. Henderson Babington, M. D.; were elected members of the Academy.

W. H. HARDINGE, M. R. I. A., communicated the following paper:—

ON CERTAIN MANUSCRIPT TRANSLATIONS OF A PORTION OF VIRGIL'S ÆNEID, COMPILED BEFORE 1690.

I OFFER on behalf of my friend, Francis Cumming, Esq., of Woodstock, in the county of Galway, J. P.—to be placed in the Library of the Academy as a deposit in trust for him and his heirs male—three manuscript volumes, containing metrical translations into English of the 3rd, 4th, 6th, 8th, 9th, 11th, and 12th Æneids of Virgil.

Upon the first sight of these volumes on the drawing room table of my friend, their venerable aspect and foreign material and manufacture induced me to open and examine them; and I soon became much interested in what appears to me to be an eminently literal rendering into English verse of the well-remembered classical companions of bygone days; but discovering in the ninth and eleventh Æneids marginal annotations acknowledging Dryden to have been the contributor of the Episode of Nisus* and Euryalus, and John Stafford of that of Camilla†—and, further, finding that the third Æneid is certified to have been finished at St. Germains on September 18, 1692, and that the fourth Æneid was rewritten three several times successively by persons bearing the surnames of Bryerly, Bysh, and Dalton, and, after having undergone 486 corrections, was then submitted to the judgment of Dryden, combined interest and curiosity influenced me to the attempt of discovering the author of these volumes.

After having taken much pains in this research, and unravelled the mystery, I found that the same voyage of literary discovery had been successfully accomplished by Mr. Lentaigne, who contributed a paper on the subject, published in the Academy's "Proceedings,"‡ under the date of May 13, 1839.

That communication supplies all that is known of the history of the manuscript volumes, and notices the particulars above described; also the more important one, that an ineffectual attempt had been made to obliterate the name "Lauderdale" from a fly leaf of one of the volumes; and the writer further states that he compared the translations with the corresponding Æneids of Lauderdale's Virgil, published in 1709, and expresses an opinion that these manuscripts are the originals from which that publication, *pro tanto*, originated. In this criticism I agree with Mr. Lentaigne; but I disagree with that gentleman in his adoption of an early charge of plagiarism from these manuscripts made against Dryden, and consider that Dryden's statement, introduced in the preface to the first edition of his incomparable work, published in 1697, namely, "that he was permitted by Lord Lauderdale to make use of his Lordship's translation, and that he consulted it as often as he doubted of Virgil's sense," may be received as unquestionable truth; indeed, the style of these contemporaneous authors is so different, that neither could with any chance of success adopt the metrical translation of the other as his own. Lauderdale is a close translator, and in that all his merit lies; Dryden is emphatically a poet—graceful, smooth, and aspiring—qualities rarely present in the composition contained in the manuscript volumes now presented to the Academy. These volumes are fragments of an entire work, compiled on the Continent of Europe, and the circumstance is quite appropriate to the history of Richard Earl of Lauderdale, who was a Jacobite, accompanied King James in his expatriation, was at his court at St. Germains in the year 1692, and died at Paris in 1695. There can be no reasonable doubt that the manuscript volumes are a portion of his Lordship's work, or that that work was completed before Dryden's more classical production was even thought of.

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* 9th Æneid, lines 283 to 667.

† 11th Æneid, lines 721 to 925.

‡ Vol. i., p. 309.

Mr. P. W. Joyce read a paper "On the Changes and Corruptions in Irish Topographical Names."

Mr. W. G. Brooke, by permission of the Academy, read the following paper:—

Notes on an Old Irish Canoe found in Lough Owel, Co. Westmeath.

In the close of last year an old Irish Boat was safely lodged within the walls of this house. Beyond question the most fitting depository for the largest and noblest of these relics of bygone years ever found in this country is the Royal Irish Academy. Actuated by this view, Mr. Charles Levinge, of Mullingar, the fortunate finder of the Boat, presented it to this institution, and it now lies in the rooms beneath us. It is this old Boat which I desire this evening to introduce to your notice, and briefly to describe. My claim to stand here rests, I regret to say, not on my privilege as an Academician, but merely on the fact that, having visited this Boat shortly after it had been raised from its watery bed, I assisted Mr. L. in having it safely transported to Dublin, and brought it under the notice of Sir William Wilde, one to whose valuable labours, and helpful and ready sympathy on the subject of Antiquities, we are all deeply indebted.

The Boat with which I have to do was found in Lough Owel, in the county of Westmeath. In its immediate neighbourhood is a crannogue not yet explored, and hard by two other smaller canoes not yet raised, and which, if the season be favourable, will be taken up in the course of the summer. After the drought of last year the depth of the lake diminished by several feet; and Mr. Levinge, while seated in his row boat, on looking through the water, was attracted by a long piece of black wood, which, while its main portion reposed on the peat, reared a curved beak somewhat proudly from its bed. Further attention confirmed his first impression, that it was an old Boat of enormous length, its bottom covered with a deposit of lake mud several inches in thickness, and lying at that time in water somewhat less than a fathom deep. It required some skill to float so large and so valuable a prize—its sides worn to a knife edge, and ground down by the washing of the tides; its frame pierced through and through with many rows of holes; its stern board knocked out, and its oaken sides weighed down with the saturation of the water of centuries—altogether a boat requiring care, and sympathy, and tender handling.

I shall now briefly describe the canoe, giving its dimensions. As I have already said, it is a single-piece canoe, carved, and hollowed, and fashioned out of a noble oak of the primæval forest. It is forty-two feet long, and three feet five in breadth. Hitherto the boats which have been found in Ireland have not exceeded twenty-eight feet in length; and Sir Charles Lyell mentions a famous Swiss canoe of fifty feet long, and three and a half wide, as the largest which has ever been picked up on the Continent. Had we this Irish canoe as she was originally designed and launched—unworn by the erosion of the water, and unsmitten by the wasting hand of time—it would probably measure some forty-four feet in length, and represent a width of four and a half feet. But, be that as it may, this magnificent Boat may now be pointed out as the Irish analogue of her great Swiss sister, mentioned by Sir C. Lyell. The sides are imperfect; but one has suffered by the wearing action of the water more than the other. That its almost entire disappearance is due to this cause is shown by the thinning down of the total thickness of the bottom of the Boat to a sharp edge along the present ruined gunwales. The comparative preservation of one side is easily accounted for by the fact that it was protected on its exterior face by two rough hewn oak planks, which lay close up against it. The construction of the bow and stern differs most materially, but is similar in principle to a large boat already in possession of your Academy.

If strength were aimed at, it might have been expected that the principle of the curved bow of the boat would have been carried out in its after end. This, however, is not so; for, while the entry is spoon-shaped, the stern, such as it is, represents a section of a boat cut in two amidships. But we are not left in the dark as to the peculiarity of the stern; for a hollow groove at the very end passes from one side to the other, into which the stern board fitted. This, unless they had some peculiar method of securing and caulking, must have been the weakest part of the Boat. The groove is remarkably well preserved, but of shallow depth. The width, two and a half inches, gives us the thickness of the stern board. In place of being flat-bottomed and straight-sided, as are the large boats hitherto found, the section of the canoe exhibits as delicate and fine a curved form as any frigate of Sir William Symonds, or blockade runner of Mr. John Laird's. Preserved from erosion by the lake mud deposit, the bottom has a solid thickness of five and a half inches, and probably it never was thicker than half a foot; but this is enormous, greatly adds to its weight, and enlarges our view as to its pristine proportions and strength. The lines are fine, and of arrowy straightness, without a trace of sinuosity or distortion, and the timber for the most part is in robust and admirable condition. In forming an estimate of the size of the tree out of which this canoe was fashioned, I may here allude to the fact, that it exhibits no sign of sap wood; and I am informed by those who have examined into this point, that its diameter, as it stood erect in the forest, must have been eight or nine feet. The mode employed in felling it was probably by fire, assisted by such chopping tools as the country people could command.

Notwithstanding the wonder of its size, I now come to the most interesting topic in connexion with my subject; and here I am happy to have the assistance of a drawing behind me, to which I beg your attention, and which represents the inner face of the Boat. I refer to the number of holes which are drilled through the sides or bottom of the canoe, carefully drilled, and in a most workmanlike manner, suggesting sharp tools, and skill in the handling of them. The total number of holes, or parts of holes, which we find is forty-eight. The feature of holes in these old boats is not unusual, but this extraordinary number is most unusual. On looking over the boats down stairs this morning, I found in one boat six small holes, three on each side, and in one of them a plug, which appears to have been broken off violently. In another boat three holes, also very small, not large enough to thrust in a towel pin of modern make, and arranged along the centre of the bottom of the boat. But here we have forty-eight holes, twenty-four along the bottom, and twenty-four lateral ones, of seven of which latter the waste of the sides has left but imperfect sections.

The first thought which is suggested by these holes is the apparent regularity with which they are arranged, and the careful marks of design which their relative positions emphatically proclaim. An inspection of the drawing will show that along the bottom, at stated and constant intervals, we have twenty-four holes in two longitudinal and parallel lines, or twelve in each long row. Viewed transversely, or across the boat, we have twelve pairs of holes, each pair lying in the same right line, and suggesting close connexion in their aim and object. They are pierced right through the unvarying thickness of the bottom, which I have already stated to be five and a half inches. In some of them were found plugs of pine inserted from the interior, as is evident from the lower ends of them being chipped with a fine tool. These plugs were in a very soft and ruinous condition with water saturation.

I now come to the lateral holes, of which there were twelve on each side. A glance at the drawing will show the same evident care observed in their arrangement, and such a connexion between them and the ones of which I have already spoken, that any theory attempting to account for them independently would seem to be untenable. For, consider the position of these lateral holes— first of those on the side of the boat which is most worn away. They lie somewhat roughly, but for the most part accurately enough, in a line with their respective neighbour holes in the bottom of the boat. This seems at once to establish a connexion between them. There remain the lateral holes on the other, or well preserved side; and here we meet an element of irregularity—distinguished, however, by a rude method of its own, which we must not overlook. Commencing, then, at the bow—the first hole on this side is slightly in advance towards the bow of an imaginary line drawn across the centre of the three holes opposite to it. Walking aft, the next hole is somewhat on the other, or stern, side of such a line. As we proceed further on, we find these lateral holes widening out in each case from such imaginary lines, but seemingly obeying the law of a rude gradation, until the last hole on this side is found outside the groove, and consequently behind the stern board. I have dwelt with some particularity on these holes; for they seem to involve a curious puzzle, which has not yet been cleared up. I have only further on this point to draw your attention to the propinquity of two of the bottom holes to the tail board, and to state that the lateral holes probably lay below the line of flotation, and that they are drilled downwards from the interior at a considerable angle. If the holes are to be regarded as of equal antiquity with the shell, there is no theory so far as I know which accounts for them satisfactorily, and but one which rests on a sufficient amount of probability. If any gentleman present can explain them, I can assure him that I know numbers of people whose curiosity has been excited, and who will be glad to learn his views. It appears, however, to me, that this magnificent piece of wood, once a boat, was afterwards employed for other purposes, to fulfil which it became necessary to perforate her in the manner in which we now possess her. Some light may be thrown upon the subject when the other two canoes shall have been raised. In the absence of Captain Burton, Mr. Clibborn has asked me to mention the view which he threw out on looking at this boat last week. It is, as I understand, common among certain tribes in Africa to construct their boats of three pieces; one is for the bottom, theother two for the sides. Now, the sides overlap the central piece, and are bolted to it with wooden rivets. It occurred, therefore, to Captain Burton that this canoe is but the central fragment of the old boat, and that the lateral holes received the bolts whereby the sides were fastened on. The period of the construction of this canoe I am inclined to fix in the age of Bronze. In Denmark, the Bronze age is always associated with the oak; and the lake dwellings in the central and western portions of Switzerland belong exclusively to that period. Though much fine work has appeared from flint implements, and though lake dwellings of the Stone period are frequent in eastern Switzerland, yet the size and finish of this relic point to a period of sharp cutting tools. The old bronze, rivalling in temper and strength our modern steel, would naturally furnish weapons of the requisite toughness to fashion the arrowy and curved sides of this admirable specimen of early naval architecture. But, if the boat is later in date than the Stone, it would seem to be earlier than the Iron age. In this age saws appear for the first time. Careful search has never brought to light a bronze saw. Now, if you have a saw, you do not hollow a boat forty-two feet long out of a single tree; it saves time and labour to build it of planks. Robinson Crusoe, who had only an axe, did not dream of doing so; with infinite trouble he chopped the stems of trees into planks to construct his boat. Thus, I should be inclined to say that this boat belongs to the close of the Bronze period, when bronze tools had arrived at some perfection; or to the early dawn of the Iron age, before saws were known or in general use.

A very few words as to the method used to raise the boat from the bed of the lake, and to bring it to shore. The credit of this difficult work is due to Mr. Adams Reilly—a gentleman who I am happy to say is present this evening; and if I fall into error, he can correct me. When found *in situ*, the canoe was resting on the peat. Fortunately, owing to the droughts of last summer, the lake had shoaled to five feet of water. The first step taken was to lighten it of the deposit of lake mud. In this mud were found some bones (not human); and an old copper ring, which may have come off some angler's rod. Piles were then driven down into the lake on either side of the bow of the boat; across their heads was placed a timber platform, which bore a windlass fitted with a stout chain. This chain was first passed under the bows, and hove on; and immediately, the hinder part still remaining firm, the bows were brought to the level of the water. The chain was then passed astern, and fastened to two of the holes amidships. In front of the bows was placed a light wooden raft, or cradle, constructed for the purpose of keeping the boat's head up. It was now drawn forward by the windlass, so that the head lay supported on the raft; and the stern, which was immediately afterwards raised, was brought beneath the platform. With her after portion buoyed up by two boats, she was taken in tow by a third boat, manned by Westmeath boys, and conveyed a mile and a half down the lake, when for the first time—for how many years shall I say?—she touched the shore. With the aid of horses, wheels, rollers, and the usual assembly of rustics who attend on such ceremonies, it was conveyed up to Levington Park in the beginning of last September. An object of considerable interest and attraction to numbers, it remained there till the end of the year, when Mr. L. presented it as a new year's gift to the Royal Irish Academy.

The following donations were received:—

An antique silver finger ring; presented by C. Davis, M. D.

Two Irish MSS., containing a Life of St. Patrick, and a Collection of Irish Poems; presented by John A Nicholson, M. R. I. A.

MONDAY, FEBRUARY 27, 1865.

The Very Rev. Charles Graves, D. D., President, in the Chair.

No papers were read.

THURSDAY, MARCH 16, 1865.—Stated Meeting.

The Very Rev. Charles Graves, D. D., President, in the Chair.

The Secretary of the Council read the following—

Report of the Council.

Since the date of our last Report one paper has been printed in the "Transactions," and issued to the Members of the Academy—namely, that by the Rev. Dr. Reeves "On the Culdees." Three are in the hands of the printers, viz.—Captain Meadows Taylor's "On the Cromlechs and other Antiquarian Remains in the Dekhan;" Rev. Professor Haughton's, "On the Semidiurnal Tides at Cahirciveen;" the President's, "On an Undescribed Class of Monuments;" and Mr. W. H. Hardinge's "Concluding Memoir on MS. Mapped and other Townland Surveys in Ireland."

It was stated in the Report of last year that the printing of Captain Meadows Taylor's paper had been completed, and that its issue was prevented only by a delay in the execution of the Illustrations. The Council regret that this obstacle still prevents its publication. The same difficulty has also retarded the issue of the "Proceedings" of the Academy. Since 16th March, 1864, one part has appeared, completing Vol. viii., and containing an Index to that volume. A considerable number of additional papers are now printed; but from the impossibility of obtaining the necessary woodcuts from the engraver, the issue of the first part of Vol. ix. is delayed. The attention of the Council has been directed to these embarrassing circumstances; and they have at present under consideration the best means of securing a greater promptitude in the execution of the illustrations, and, what will be the immediate consequence, a speedier publication of the "Proceedings."

Many interesting and important communications have been brought before the Academy during the past year. We have had papers on Scientific subjects from Sir Wm. R. Hamilton, the Rev. Professor Haughton, Professor Downing, Professor Sullivan, Mr. David Moore, Mr. George C. Garnett, Mr. George C. Knox, Mr. Alexander Macalister, Major Paul W. Phillips, R. A., Lieut. J. Haughton, R. A., and Mr. John Locke; in Polite Literature, from the Rev. Dr. Reeves, Mr. W. H. Hardinge, Lord De Ros, Mr. G. C. Garnett, Mr. Samuel Ferguson, Mr. D. H. Kelly, Mr. P. W. Joyce, and Mr. Herbert Hore; in Antiquities, from the President, from Captain Meadows Taylor, Sir Wm. R. Wilde, Mr. S. Ferguson, Mr. George H. Kinahan, Mr. Du Noyer, Mr. E. A. Conwell, Mr. Henry O'Hara, and Mr. W. G. Brooke.

During the past year the Library has received donations to the extent of 203 volumes, chiefly contributed by bodies with which the Academy exchanges publications. We are indebted to the liberality of the French Government for a series of the valuable historical publications issued under the direction of the Minister of Public Instruction. A further portion of the arrears of binding has been executed; and to this department has been allocated a sum of £29, bequeathed to the Academy by the late Mr. Beriah Botfield.

The Collection of Antiquities has been increased during the past year by eighty-nine donations, sixty-one articles obtained by purchase, and seventy-six procured under the Treasure-trove regulations, amongst which are several gold ornaments of considerable value. Mr. Marcus Keane has deposited in the Museum a valuable relic from the county of Clare, called the "Clog Or."

Nearly all the cases in the Museum being now full, it has been suggested that more accommodation, as well as better light, would be obtained by removing the Collection of Antiquities to the spacious and handsome room, available for the purpose, on the second story of the Academy's house.

In April, 1864, the House of Commons appointed a Select Committee to inquire into the condition of the Scientific Institutions of Dublin which are assisted by Government aid. The Very Rev. the President, Sir W. R. Wilde, and the Rev. Professor Jellett were examined at length by the Committee on the present state and requirements of the Academy. In their Report the Committee speak in very high terms of the public services rendered by the Academy. "This Society," they observe, "has had upon its lists since its foundation almost every man in Ireland distinguished in abstract science, in the sciences of experiment and observation, in literature, and in archæology; it has illustrated the history and character of its own country by works of originality and importance; it has further illustrated and awakened an interest in that history by its Museum of Irish Antiquities. The liberality of its members in contributing to those objects is deserving of remark. As a peculiarly national institution, it has no ordinary claims for support in carrying out its present work, and for encouragement in extending it."

The requirements of the different departments of the Academy, to enable it to do its work with efficiency, were strongly pressed on the notice of the Committee.

The representations thus made are adopted in the Report; in which the "Committee state that assistance is required to enlarge the Museum, to increase the staff, and to aid scientific researches;" and they express the opinion that the Academy "has the strongest claims on the liberality of Parliament."

The Council have addressed a Memorial to the Lords of the Treasury, founded on these statements in the Report of the Committee, and praying that the increased Grant necessary for the effective performance of the work of the Academy may be included in the Estimates to be laid before Parliament in the current year. A copy of this Memorial is given as an Appendix to the present Report.

There are now on the books of the Academy 361 Members; of these 203 are Life, and 158 Annual Members.

We have lost by death within the year three Honorary Members, viz.—

1. Baron Giovanni Plana, Astronomer Royal, and President of the Royal Academy of Sciences at Turin;
2. Charles Christian Rafn, Perpetual Secretary of the Royal Society of Northern Antiquaries;
3. Frederick George Wilhelm Struve, from 1839 to 1862 Director of the Astronomical Observatory at Pulkowa;

and seven Ordinary Members, viz.—

1. Arthur B. Cane, Esq.; elected June 13, 1842.
2. Christopher Coppinger, Esq.; elected January 12, 1863.
3. H. T. Cusack, Esq.; elected January 14, 1861.
4. Joseph Dickinson, M. D., F. R. S.; elected January 12, 1852.
5. Lord William Fitzgerald; elected November 12, 1849.
6. William Smith O'Brien, Esq.; elected April 23, 1857.
7. Edward James Senior, Esq.; elected January 8, 1854.

The Academy has elected during the year thirteen Ordinary Members, viz.—

1. Thomas H. Babington, M. D.
2.*Robert H. Beauchamp, Esq.
3. Sir Victor Brooke, Bart.
4. Charles P. Cotton, Esq., C. E.
5. Most Rev. the Archbishop of Dublin.
6.*W. M. Hennessy, Esq.
7.*P. Joseph Keenan, Esq.
8.*J. J. Lalor, Esq.
9. Alexander Mac Donnell, Esq., C. E.
10. Hon. Thomas D'Arcy M'Gee, M. P. (Canada).
11. Thomas M. Madden, M. D.
12. Rev. C. P. Meehan.
13. Alfred Power, Esq.

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* Those marked with * are Life Members.

APPENDIX TO THE REPORT OF THE COUNCIL.

Memorial to the Lords Commissioners of Her Majesty's Treasury.

MY LORDS—The Council of the Royal Irish Academy have recently transmitted to your Lordships the usual Estimate of their Income and Expenditure for the year ending March 31, 1866. In stating the several heads of their expenditure, they thought it right to restrict themselves, in the first instance, within the limits prescribed by the operations of the Academy in former years. But they have long felt, both that the efficiency of this Institution for accomplishing its recognised objects is seriously impeded by the smallness of the resources at its disposal, and also that it is in the highest degree desirable that such an extension of its operations should take place, as without increased assistance from Parliament it would not be possible to carry into effect. They desire now to call the attention of your Lordships to the testimony relating to both these points contained in the recent Report of the Select Committee of the House of Commons on the Scientific Institutions of Dublin.

It is stated by the Committee that the Royal Irish Academy "has acquired the highest reputation for the learning and activity of its researches;" that its "Museum is the richest and most important in Europe in Celtic Antiquities; that its Library contains Manuscripts and Works of great value, illustrative of early Irish History; and that it has published Papers, scientific and antiquarian, of no ordinary interest." The Committee also point out the inconveniences which have arisen from the "small amount available for the pressing and absolute wants of the several departments of the Academy." And they further state that "assistance is required to enlarge the Museum, to increase the staff, and to aid scientific researches;" and express their opinion that the Academy "has the strongest claims on the liberality of Parliament."

It is right to inform your Lordships that frequent appeals have been made to the generosity of the Members of the Academy, for the purpose of supplementing the deficiency of public aid; and the Committee state in their Report that these appeals have been most liberally responded to. But it would be highly injudicious for the interests of the Academy to endeavour to push further the practice of collecting private subscriptions towards the accomplishment of its objects. Much dissatisfaction would thus be created, and the apprehension of such repeated calls would probably have the effect of deterring many persons from becoming candidates for admission.

The specific purposes for which an increase of the Parliamentary Grant to the Academy is felt to be necessary are given as follows in the Report of the Select Committee:—

	£	s.	d.
1. For the preparation of Scientific Reports on the Irish Tides, Terrestrial Magnetism, Meteorology, &c., including cost of instruments, and grants to observers, ...	200	0	0
2. Salary to an Irish Scribe, including cataloguing and printing Irish Manuscripts, ...	200	0	0
3. Salary to a Museum Clerk, purchase of Antiquities, cost of making Casts and Photographs to be exchanged with other collections, .	200	0	0
4. Salary to a Library Clerk, with cost of Books and binding, . .	200	0	0
5. Printing and Illustrating the "Transactions" and "Proceedings,"	200	0	0
Total amount of required increase to present Annual Grant of £500, ...	£1000	0	0

The Council hope that they may be permitted to lay before your Lordships a few remarks on each of these heads of expenditure.

First, as to the preparation of Scientific Reports on the Irish Tides, &c., they beg to state that a regular system of tidal and meteorological observations round the entire coast of Ireland was instituted some years since by the Academy, and continued for more than twelve months, at very great expense. Results of great importance were thus arrived at; but, notwithstanding large assistance from individual members, it was impossible to complete the reduction of the observations. It is the opinion of the scientific members of the Council that it would be extremely desirable to institute a complete set of meteorological observations at inland stations; but this and other similar researches the Academy, with its present resources, is quite unable to undertake.

Secondly, as to procuring the services of an Irish Scribe: it is most important that the Academy should have in its employment one or more persons well acquainted with the ancient Irish language, to catalogue, transcribe, translate, and edit works of historic and antiquarian interest in the Academy's collection of Irish Manuscripts, as well as to copy for the Academy valuable Manuscripts which exist in other libraries, at home or abroad. It may be remarked that Her Majesty's Government have recently determined, on the recommendation of the Commission of Inquiry into the Queen's Colleges, to suppress the only offices set apart for the study of Irish literature in this country—namely, the Celtic Professorships in those Institutions. It was the opinion of that Commission (and the Select Committee have expressed their concurrence in this view) that the objects which were sought to be attained by the foundation of those Professorships may be better accomplished by providing the means of employing scholars in connexion with the Academy, where a large body of Irish Manuscripts has been brought together, and every appliance for study and research would be available. It may be added that, as the Irish language is dying out, the difficulty of obtaining the services of competent Irish scholars will be constantly on the increase.

Thirdly, additional aid is required for the safe keeping and improvement of the Museum. The value of the collection of Antiquities in the possession of the Academy is universally acknowledged, and has been fully recognised by the Select Committee. But, from scantiness of funds, it is impossible to purchase many valuable articles which are offered by the finders. The public are freely admitted to inspect the Museum; but there is great need of a Curator, who could give constant attendance, and whose business it should be, not merely to make arrangements for the safe custody of the subjects in the collection, but to give useful information to visitors. He would also be employed in superintending the making of Casts and Photographs, to be exchanged with other collections.

Fourthly, a salary for a Library Clerk is required, as well as additional funds for the purchase of books, and for binding. Both for the convenience of readers and the safety of the books and manuscripts they may consult, and also for the recovery, at stated periods, of volumes lent to members, it is necessary to have an attendant permanently and exclusively occupied with these duties. The Library of the Academy is particularly rich in the Transactions of learned societies, and in works relating to Ireland; and it is only the want of a sufficient staff which prevents the Council from making it still more available for the use of the public than it has hitherto been.

Fifthly, the Academy requires aid towards the printing and illustration of its "Transactions" and "Proceedings." The knowledge of the smallness of the funds now available for these purposes prevents persons from coming forward to read papers; and several valuable communications have, for this reason, been withdrawn from us, and presented to learned societies elsewere. There is a special difficulty with respect to papers on natural science, arising from the expense attending the illustrations which are absolutely necessary to make them intelligible and useful.

For all these reasons, the Council of the Royal Irish Academy beg leave earnestly to urge upon your Lordships the propriety of making such increased provision for the wants of the Institution as has been suggested in the Report of the Select Committee; and respectfully request that your Lordships will include in the next Estimates to be submitted to Parliament an additional Grant to the Academy of £1000.

I have the honour to be, my Lords,
Your Lordships' obedient humble Servant,
CHARLES GRAVES, D. D.,
President of the Royal Irish Academy.

RESOLVED,—That the Report now read, with the Appendix, be received and adopted by the Academy.

The ballots for the annual election of President, Council, and Officers, having been scrutinized in the face of the Academy, the President reported that the following gentlemen were duly elected:—

PRESIDENT.—The Very Rev. Charles Graves, D. D.

COUNCIL.—Rev. J. H. Jellett, A. M.; Robert W. Smith, M. D.; Robert M'Donnell, M. D.; William K. Sullivan, Ph. D.; Joseph B. Jukes, A. M.; George Johnstone Stoney, LL. D.; and Rev. George Salmon, D. D.: on the Committee of Science.

Rev. Joseph Carson, D. D.; John F. Waller, LL. D.; John Kells Ingram, LL. D.; John Anster, LL. D.; R. R. Madden, M. D.; Rev. George Longfield, A. M.; and Captain Meadows Taylor: on the Committee of Polite Literature.

John T. Gilbert, Esq.; Rev. William Reeves, D. D.; George Petrie, LL. D.; W. H. Hardinge, Esq.; Rev. James H. Todd, D. D.; Sir W. R. Wilde, M. D.; and Charles Haliday, Esq.: on the Committee of Antiquities.

TREASURER.—Rev. Joseph Carson, D. D.

SECRETARY OF THE ACADEMY.—Rev. William Reeves, D. D.

SECRETARY OF THE COUNCIL.—John Kells Ingram, LL. D.

SECRETARY OF FOREIGN CORRESPONDENCE.—Sir W. R. Wilde, M. D.

LIBRARIAN.—John T. Gilbert, Esq.

CLERK, ASSISTANT LIBRARIAN, AND CURATOR OF THE MUSEUM.—Edward Clibborn, Esq.

The President under his hand and seal nominated the following

VICE-PRESIDENTS.—Rev. J. H. Jellett, A. M.; Joseph Beete Jukes, F. R. S.; John F. Waller, LL. D.; and George Petrie, LL. D.

The Secretary having reported that there was no further private business to be transacted,

Mr. William H. Hardinge read a paper "On Certain Irish Census Returns attributed to the Year 1659."

Mr. P. W. Joyce read a paper (in continuation) "On Changes and Corruptions in Irish Topographical Names."

Sir William R. Wilde presented the following antiquities:—

On the part of Lord Farnham, forty-one silver coins, chiefly of the reigns of Elizabeth, James I., and Charles I., all found in the Toneymore Crannoge, county of Cavan, already described in the "Proceedings." They serve to mark a period in the later occupation of the Crannoge, and largely contribute to the extensive collection of coins already possessed by the Academy. Sir William expressed a hope that some numismatist would undertake the arrangement of these coins, and the others in the Academy's fine collection of coins, medals, and tokens.

Also, from the same locality, a number of large boars' tusks; two spindle whorls of bone; a spoon made out of the epiphysis of the long bone of a ruminant, similar to those described in the "Museum Catalogue," p. 267. They complete the collection of articles found at Toneymore.

A large socketed celt, 2¼ inches long, broad and flat, found in the county of Westmeath.

A winged celt, stopped and decorated, 5½ inches long, also from the county of Westmeath.

From Dr. Malcomson, of Cavan, a long narrow stone celt, 10½ inches long by 3 broad in the widest portion, and much weathered, possibly from exposure to the air, found at Lough Oughter, Co. Cavan, on the Farnham estate.

Also, from the same locality, a very perfect massive stone celt, of greenstone porphyry. It is highly polished, and the curved cutting edge almost as sharp as metal. It measures 8½ inches long by 3⅛ broad, and is especially remarkable on account of the roughened surfaces on both outer edges, near the narrow end, evidently produced after the celt had been polished, and no doubt serving to retain it with greater security in the handle.

An ancient single-piece left shoe, 8½ inches long, with two seams—one from the instep to the toes, where the material has been carefully gathered in; and the other behind the heel, where the gut sewing still remains. This article, in which the hair side of the hide was external, is not dissimilar in make to the pampoota still used in the western islands of Arran. It was found, four feet below the surface, in Derrywinney bog, in the parish of Kilmore, county of Cavan.

Three veryperfect bronze rings, each 3½ inches in diameter, found at Gortermore Lake, during the drainage of Loughs Oughter and Gowna, in the parish of Killeshandra, county of Cavan.

A small bronze spur, found in the interior of Lough Oughter Castle.

A large socketed celt, 3¾ inches in length, found in Cromwell's Pass, in the parish of Kilmore, county of Cavan.

Fragment of a large iron shot, from Lough Oughter Castle.

From Denis Florence M'Carthy, Esq.: a long narrow-winged celt, 6¼ by 1¾ inches, very rudely cast, and containing a greater proportion of copper than is usual in such instruments; found at Calorguen, near Dinan, in Brittany. It is somewhat longer and more slender in the blade than the Irish form, and resembles those from the neighbourhood of Cape Finisterre, described in the "Proceedings," vol. viii., p. 153.

From Arthur Nugent, Esq., a small socketed bronze celt, 2½ inches long, looped and decorated, broad-edged; said to have been found in the county of Westmeath, in a sod of turf.

MONDAY, APRIL 10, 1865.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

Richard R. Brash, Esq.; Captain Richard F. Burton; John Freeland, M. D.; Rev. Arthur B. Frazer; William Francis de Visme Kane, Esq.; Major W. Armstrong Mac Donnell; and Rev. Silvester Malone; were elected members of the Academy.

Mr. J. T. Gilbert read a paper, "On the first Parliament held in Ireland under Poynings' Law; with some Account of its Statutes which were declared to have been lost."

The President read a paper, communicated by the Rev. E. Hincks, D. D., "On the Assyrio-Babylonian Measures of Time."

The following donations were received:—

Translation of Goethe's Faustus, Part II.: presented by John Anster, LL. D.

A copy of "Aquæ Solis; or Notices of Roman Bath," by the Rev. H. M. Scarth: presented by Lord Talbot de Malahide.

A copy of the "Œuvres Philosophiques, Historiques, &c., d'Alembert," 18 vols., 8vo: presented by the Rev. T. Romney Robinson, D. D.

A selection of worked flints, collected in the neighbourhood of Jubbulpore, in Central India, by the late Lieutenant Swiney: presented by Mr. John Evans, on the part of Sir Charles Lyell.

An ancient and elaborately ornamented cinerary urn, containing fragments of bones and shells. Presented by R. F. M. St. George, Esq.

MONDAY, APRIL 24, 1865.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

Dr. Henry Hudson presented vols. i., ii., and iv. of "L'Art de Verifier les Dates"—thereby completing the copy of that work previously presented to the Library.

The Rev. Dr. Todd presented a copy of his work on "The Books of the Vaudois."

The Rev. Beaver H. Blacker presented a copy of his "Sketches of the Parishes of Booterstown and Donnybrook."

Edward Sellon, Esq., presented a copy of his "Annotations on the Sacred Writings of the Hindús."

Maurice Lenihan, Esq., presented two large Bombshells, found in excavations made at St. John's Gate, Limerick.

Aquilla Smith, M. D., presented seven specimens of spurious Antiquities, said to have been found in the River Thames.

The Librarian, on the part of the French Government, presented a large collection of historical and antiquarian works, printed under their direction.

The special thanks of the Academy were returned to the French Government for their valuable donation; and also to M. Livio, Consul for France in Dublin.

MONDAY, MAY 8, 1865.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

William J. O'Donnavan, LL. D., was elected a member of the Academy.

W. H. Hardinge, Esq., read a paper, "On an Unpublished Essay on Ireland, by Sir William Petty, A. D. 1687."

The PRESIDENT read the following letter from the Under Secretary of State for Ireland:—

"*Dublin Castle, May 6*, 1865.

"SIR,—Referring to your letter of the 22nd February last, I am directed by the Lord Lieutenant to acquaint you, for the information of the Council of the Royal Irish Academy, that a communication has been received from the Lords Commissioners of Her Majesty's Treasury, stating that they have had under consideration the Memorial which accompanied your letter.

"Their Lordships are desirous of giving due weight to the opinion expressed by the Select Committee of the House of Commons in favour of the Academy; but they are not prepared to recommend to Parliament to make Grants in favour of the Museum and Library of the Institution; while, as regards Meteorological Science, sufficient provision appears to be already made by the establishments under the Admiralty and the Board of Trade; and their Lordships have thought it right to confine themselves to adding to the provision now made in the Estimate in aid of the publication of the 'Transactions' of the Academy a sum of £200 specially for encouraging the study of ancient Irish MSS., as materials of history, by forming Catalogues and Translations of them, and making them

MONDAY, MAY 22, 1865.

The Very Rev. Charles Graves, D. D., President, in the Chair.

On the recommendation of the Council, it was—

Resolved,—That a sum not exceeding £20 be granted by the Academy, to have a certified transcript made of the Census Returns of 1659, upon which a paper was recently read by Mr. Hardinge.

Mr. Patrick W. Joyce, A. M. T. C. D., M. R. I. A., read the following paper:—

On Changes and Corruptions in Irish Topographical Names.

I have often observed that there are many interesting peculiarities in the process of altering Irish topographical names from ancient to modern English forms; and that the changes and corruptions they have undergone are, in numerous instances, the result of phonetic laws that have been in operation from the earliest times, and among different races of people. Irish names, moreover, afford the only existing record of the changes that Irish words undergo, in the mouths of English-speaking people. For these reasons the subject appears to me to possess some importance, both in an antiquarian and philological point of view; and I have thrown together the following observations, with the hope that they may prove interesting to the Academy.

In anglicising Irish names, the leading general rule is, that the present forms are derived from the ancient, as they were spoken, not as they were written. Those who first committed them to writing aimed generally at preserving the original pronunciation, by representing it as nearly as they were able in English letters. The great majority of names are anglicised on this principle; and, allowing for the difficulty of representing Irish words by English letters, it will be found that, on the whole, the ancient pronunciation is fairly preserved. Whenever it so happens that the original combination of letters is pronounced nearly the same in Irish and English, the names are commonly modernized without much alteration either of spelling or pronunciation; as for instance, *dun*, a fort, is usually Anglicised *dun* or *doon; bo*, a cow, *bo; druim*, a long hill, *drum; leitir*, a wet hill side, *letter*, &c. In most cases, however, the same letters do not represent the same sounds in the two languages; and accordingly, while the pronunciation was preserved, the original orthography was in almost all cases much altered. I do not now speak of corruption: if the present letters convey the original sound without material alteration, we do not call it corruption, though the written form of the word be changed. For example *gabhailin* (pron, gowleen), a little [river] fork, is properly anglicised Goleen (in the parish of Kilmoe, Cork); but when it is made Golden (a village in Tipperary), this is a corruption.

To the general rule now stated, there is a remarkable exception of frequent occurrence. In many names the original spelling is either wholly or partly preserved;—in other words, the modern forms are derived from the ancient, not as they were spoken, but as they were written. In almost all such cases, the names are pronounced in conformity with the powers of the English letters; and so, whenever the ancient orthography is retained, the original pronunciation is generally lost. This may be illustrated by the word *Rath*, which is in Irish pronounced *raw*. There are over 400 townland names commencing with this word in the forms of *Ra*, *Rah*, *Raw*, and *Ray;* these names are derived from the spoken, not the written originals; and, while the pronunciation is retained, the spelling is lost. Raheny, Ratoath, Raphoe, Raheen, Raymunterdoney, may be taken as examples. There are more than 700 names commencing with the word in its original form, *Rath*, in which the correct spelling is preserved, but the pronunciation is commonly lost, for the word is pronounced *rath* to rhyme with *bath*. It is worthy of remark, however, that the peasantry living in or near these places, to whom the names have been handed down orally, and not by writing, generally preserve the correct pronunciation; of which Rathmines, Rathgar, Rathfarnham, and Rathcoole are good examples, being pronounced by the people of the localities, Ra-mines, Ra-gar, Ra-farnham, and Ra-coole.

The principal effect of this practice of retaining the old spelling is, that consonants which are aspirated in the original names, are hardened or restored in the modern pronunciation. To illustrate these principles I have given the following short list of words that enter frequently into Irish names, each containing an aspirated letter; and after each word, the names of two places of which it forms a part. In the first of each pair, the letter is aspirated as it ought to be, but the original spelling is lost; in the second, the orthography is partly or wholly preserved, and the letter is not aspirated, but sounded as it would indicate to an English reader, and so, the proper pronunciation is lost. 1. Ath, a ford (pr. *āh*); Adare (Aṫ-ꝺaꞃa, the ford of the oak tree); Athlone (Aṫ-luain, the ford of Luan, a man's name). 2. Gaoth, wind (pr. *gwee*); Barnageehy (beaꞃna-na-ᵹaoiṫe, windy gap); Balgeeth, (baile-na-ᵹaoiṫe, windy town), the name of three townlands in Meath. 3. Ruadh, red pr. *roo*); Gortroe (Ᵹoꞃꞇ-ꞃuaḋ, red field), the name of 17 townlands throughout Ireland; Kilroot in Antrim, (Cill-ꞃuaḋ, red church). This last place is called Kilrothe in the Taxation of Down, Connor, and Dromore, A. D. 1306. 4. Dubh, black, (*pr. dŭv*); Dufferin (Ꝺuiḃṫꞃian, black third-part); Dublin (Ꝺuḃ-linn, black pool). 5. Tamh, a plague (pr. *thauv*)—Taimhleacht, a plague monument—a place where those who died of the plague were buried; Tawlaght and Tallaght, the names of several places; Tamlaght and Tamlat forming either simply or in composition, the names of about 20 townlands in the Northern counties. 6. Tamhnach a field (pr. *tawnagh*); in the aspirated forms, Tannagh, Tavnagh, Tawna, &c., it forms, or commences about 147 names; in the unaspirated forms Tamna, and Tamny, about thirty-six names, but only in the Northern counties. 7. Damh, an ox (pr. *dauv*); Devenish in Fermanagh (Ꝺaıṁ-ınıɼ, ox island); Madame, in parish of Kilmaloda, Cork, (Ꞁaᵹ-ꝺaṁ, plain of the oxen). 8. Fidh, a wood (pr. fee); Finnea, near Lough Sheelin (Ꝼıḋ-an-aṫa, the wood of the ford); Fethard (Ꝼıḋ-aꞃꝺ, high wood), the name of a parish in Wexford, and of a village and parish in Tipperary.

A remarkable instance of this hardening process occurs in the counties of Dublin, Meath, and Louth, where the Irish word bothar (pr. bōher), a road, is converted into *batter*. This word "batter" is, or was, well understood in these counties to mean an ancient road. It occurs in early Anglo-Irish documents in the form of *bothir*, or *bothyr*, which being, no doubt, pronounced as in English, was easily converted into *botter*, or *batter*. It forms a part of the following names:—Batterstown, the name of four townlands in Meath, which were always called in Irish baıle-an-ḃóṫaıꞃ, *i. e.*, the town of the road; and anglicised by changing *bothar* to *Batter*, and translating Baile to town. Batterjohn and Ballybatter are also in Meath. In Louth, near Drogheda, there is a townland called Greenbatter, and another called Yellowbatter, which are called in Irish bóṫaꞃ-ᵹlaɼ, and bóṫaꞃ-buıḋe, having the same meanings as the present names, viz., *green road* and *yellow road*.

We have also some examples in and around Dublin, one of which is the well-known name of Stonybatter. Long before the city had extended so far, and while Stonybatter was nothing more than a country road, it was—as it still continues to be—the great thoroughfare to Dublin from the districts lying west and north-west of the city; and it was known by the name of Bothar-na-g-cloch, *i. e.*, the road of the stones, which was changed to the modern equivalent, Stonybatter, or Stonyroad. It is stated in the Dinnseanchus that there were anciently five great *slighes*, or roads, leading from Tara through the country, in five different directions, and that these roads were first opened, or "*discovered*" on the night of the birth of Conn of the Hundred Battles, who began his reign in A. D. 123. According to Dr. Petrie, traces of some of these roads remain to the present day, and their localities are still remembered in tradition. One of them passed through Dublin by Ratoath, and on towards Bray, and it was called Slighe Cualann, from the name of the district to which it led, viz., Cualann, which extended round Bray and Powerscourt. Under the name of Bealach Duibhlinne (the road, or pass of the [river] Duibhlinn),* it is mentioned in the following quotation from the "Book of Rights:"—

> "It is prohibited to him (the King of Eire) to go with a host
> On Monday over the Bealach Duibhlinne."

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* Duibhlinn was originally the name of that part of the Liffey on which the city now stands.

The old ford of hurdles, which in these early ages formed the only foot passage across the Liffey, and which gave the name of Ath-Cliath to the city, crossed the river where Whitworth bridge now stands, leading from Church-street to Bridge-street;* and the road from Tara to Cualann must necessarily have crossed the Liffey at this point. There can be, I think, no doubt that the present Stonybatter formed a portion of this ancient road—a statement that is borne out by two independent circumstances. First—Stonybatter lies straight on the line, and would, if continued, meet the Liffey exactly at Whitworth bridge. Secondly—the name Stonybatter, or Bothar-na-g-cloch, affords even a stronger confirmation. The most important of the ancient Irish roads were paved with large blocks of stone, somewhat like the old Roman roads: a fact that is proved by the remains of those that can now be traced. It is exactly this kind of a road that would be called by the Irish—even at the present day—Bothar-na-g-cloch; and the existence of this name, on the very line leading to the ancient ford over the Liffey, leaves scarcely any doubt that this was a part of the ancient Slighe Cualann. It must, I think, be regarded as a fact of great interest, that the modern-looking name Stonybatter—changed as it has been in the course of ages—descends to us with a history 1700 years old written on its front.

Booterstown (near Dublin) is another member of the same family; it is merely another form of Batterstown, *i. e.*, Roadtown. In a roll of about the year 1435 it is written in the Anglo-Irish form—Ballybothyr (baile-an-ḃoṫair—town of the road), of which the present name, Booterstown, is a kind of half translation. In old Anglo-Irish documents frequent mention is made of a road leading from Dublin to Bray. In a roll of about 1470 it is called Bothir-de-Bree (road of Bray); and it is stated that it was by this road the O'Byrnes and O'Tooles usually came to Dublin.† It is very probable that the Booterstown road and this Bray road were one and the same, and that both were a continualine of road that must have led to the ancient ford over the Boyne, before the erection of the first bridge. That such a ford existed there is proved by the name Drogheda, Ꝺɼoıċeaꞇ-aṫa, the bridge of the ford.

While the majority of names have been modernized in accordance with the principles just laid down, great numbers, on the other hand, have been contracted and corrupted in a variety of ways. Some of these corruptions took place in the Irish language; but far the greatest number were introduced by the English-speaking people in transferring the words from the Irish to the English language. These corruptions are sometimes so extremely irregular and unexpected, that it is impossible to reduce them to rule, or to assign them to any general or uniform influence except mere ignorance, or the universal tendency to contraction. In most cases, however, they are the result of certain laws or principles, some of which are merely provincial, or attributable to particular races of people, while the influence of others may be traced throughout the whole of Ireland. Some of these laws of corruption have been noticed by Dr. O'Donovan and Dr. Reeves;* and I have myself given expression to some others. I have here brought them all, or the most important of them, under one view, and illustrated each by a number of examples.

I. *Effects of the Article.*—The first series of changes I shall notice, are those produced under the influence of the article. When the Irish article *an* (the) is placed before a word beginning with a vowel, it is frequently contracted to *n* alone, and this *n* was often incorporated with its noun, losing ultimately its force as an article, and forming permanently a part of the word. The attraction of the article is common in other languages also, as for instance in French: in this manner have been formed the French words lhierre, lendemain, luette, Lisle, Lami, and many others.

A considerable number of Irish names have incorporated the article in this manner; among others, the following: Naul, the name of a village near Balbriggan. The Irish name is an áıll, *i. e.* the rock or cliff, which was originally applied to the perpendicular rock on which the castle stands—rising over the little river Delvin near the village. The word was shortened to *n'aill*, and it has descended to us in the present form Naul, which very nearly represents the pronunciation. Nenagh in Tipperary was anciently called Aonaċ Ꞇheꞇe, and in later times Aonaċ-Uɼmuṁan, the fair or fair green of Ormond. n'Aonach with the article prefixed, was, in accordance with the principle of preserving the pronunciation, changed to Nenagh.

Newry (in Down) is called in Irish Iuḃaɼ-ċınn-ꞇɼaċꞇa, *i. e.* the "yew tree at the head of the strand;" and the following extract from "The Four Masters," at A. D. 1162, will explain the meaning of the name:—"The monastery of the monks at Iubhar-chinntrechta was

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* This is the proper place to remark that I have followed the authority of Dr. O'Donovan and Dr. Reeves, in translating many of the names in this paper.

[illegible] *Patrick himself* [illegible] The [illegible] and the Irish name [illegible] place [illegible] the yew [illegible] the place [illegible] English form [illegible] it is [illegible] The Newry [illegible] may be [illegible] if we suppose [illegible] were planted [illegible] of the [illegible] 1162. [illegible] in the name, began [illegible] the English language, for in the Charter of Newry, a Latin [illegible] the year 1160, it occurs twice, in one case with the *n* annexed, in the other without it, viz.: Nyvorcyntracta, and Y[illegible]. The present name Newry is merely a changed form of n'Iubhar, the yew. There are two other places called Newry, one in Wicklow, and the other in Tyrone. There are seven townlands called Nure, which is the same word, and ten called Newrath or Newragh—an Iubrach, "the yew land."

Noddans, a parish in Tipperary, *i.e.* Na Feadáin, "the brooks or streamlets;" the townland that gave name to the parish, is now called in Irish Fearann na b-feadán, the "land of the streamlets." Ninch, in parish of Julianstown, Meath—an inis, the *inch* or island. Nurney, a name of frequent occurrence—an urnaiḋe, the oratory. Navan Fort, a large rath two miles west of Armagh, the remains of the ancient palace of Emania, destroyed in A. D., 332; the Irish name is Eamhuin, the pronunciation of which, with the *n* prefixed, is almost exactly preserved in the modern name Navan. Naan island, in Lough Erne—an áin, the ring. Nuenna River, in parish of Freshford, Kilkenny—an uaithne, the green river. The River Nore is properly written an Fheoir, *i.e.* the Feoir; Boate calls it "The Nure or Oure," showing that in his time (1645), the article had not been permanently incorporated. Nobber, in Meath: an obair, the work, a name applied, according to tradition, to the English fortress erected there. Mageoghegan in his translation of the "Annals of Clonmacnoise," calls ment, and it has been perpetuated in the names of Conwal, a parish in Donegal, Conwal, in parish of Rossinver, Leitrim; Great Connell in Kildare, Cunnagavale* in the parish of Tuogh, Limerick, and other places. With *nua* (new) prefixed, it became Nuachongbhail, which also exists in several parts of Ireland, in the forms of Noughaval and Nohoval, and in Meath, in the form of Navan.† This word Nuachongbhail is the only example of a topographical term I can point out as having lost the *n*, it being supposed that the proper word was Uachongbhail, and *n* merely the article. In this mutilated state it exists in the modern names of at least three places, viz: Oughaval, in parish of Kilmacteige, Sligo; the parish of Oughaval, in Mayo, and Oughaval, in parish of Stradbally, Queen's County; this last is called by its correct name Nuachongbhail, in the "Martyrology of Donegal."

The word Uachongbhail occurs in the "Four Masters" at A. D. 1197, and this is the only instance I can adduce of its occurrence in this incorrect form in any Irish document. There can be, I think, no doubt that Nuachongbhail is the original word, for we have the express authority of Colgan that *nua* not *ua* is the prefix, as he translates Nuachongbhail by *nova habitatio*—indeed *ua* as a prefix could, in this case, have scarcely any meaning, for it never means anything but "a descendant." The separation of the *n* may be witnessed in operation at the present day in Kerry, where the parish of Nohoval is locally called in Irish sometimes Uaċoḃail, and sometimes an Uaċoḃail, the *n* being actually detached and turned into the article. (See O'Donovan's letter on this parish). That the letter *n* may have been lost in this manner, appears also to be the opinion of our Very Rev. President (Dr. Graves); for in a paper read before the Academy in December, 1852, he remarks that the loss of the initial *n* in the words oiḋċe (*nox*) and uiṁir (*numerus*) "may perhaps be accounted for, by supposing that it was confounded with the *n* of the article."

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* This place is called Cunnaġaḃáil in Irish, and it is worthy of notice, as it points directly to what appears to be the true origin of Congbhail, viz., Congabhail. I am aware that in O'Clery's Glossary, Congbhail is derived from Combbhaile (Con + baile). But in a passage in the "Book of Armagh," as quoted by Mr. W. Stokes in his Irish Glosses, I find the word Congabaim used in the sense of *habito*. The infinitive or verbal noun formation is Congabail or Congabhail, which, according to this use, means *habitatio;* and as Colgan translates Congbhail by the same word *habitatio*, there can be, I think, no doubt that Congbhail is merely a contracted form of Congabhail. Congabhail literally means *conceptio, i. e.* comprehending or including, and as applied to a habitation, would mean the whole of the premises included in the establishment.

† This name affords an instructive example of the manner in which "consonants drop off in the course of a long march." Navan is called Novane in old Anglo-Irish documents, but at present at least, history does not present us with any form of the name approaching more nearly to Nuachongbhail than this. At first sight it might seem almost incredible that this long name should shrink into Novane; but all the different steps in the process of reduction are strictly analogical, being nothing more than what take place in many other Irish names. Nuachongbhail is pronounced *noo-hong-vol*, which is softened down to Noughaval and Nohoval, as mentioned above. A change of *l* to *n*, as in Collоony from Cuil-Mhaoile, makes it Nohovan, which by merely omitting the *h* in pronunciation, as in Drumlane for Drumlahan, Glenbeagh for Glenbeha, Drogheda for Droghed-aha, &c., becomes Novan or Novane.

But how is it known that the ancient name of the place was Nuachongbhail? To this there is a very satisfactory answer. Our annalists make frequent mention of a place on the Boyne, called Nuachongbhail, and Colgan says that it "is a town (*oppidum*) in Meath on the banks of the Boyne, ten miles from Drogheda, and five from Trim." Colgan's miles are often one-fifth longer than Irish miles; and bearing this in mind, any person with a map before him, will see that Navan is the only spot answering Colgan's description. It was O'Donovan, our greatest Irish topographer, that first identified Navan with the Nuachongbhail of the annalists.

As a further confirmation of this opinion regarding the loss of *n* in Uachongbhail, I may state, that the letter *l* is sometimes lost in French and Italian words from the very same cause; as in Fr. *once* (Eng. ounce, an animal), from Lat. *lynx;* it was formerly written *lonce*, and in the It. *lonza*, the *l* is still retained. Fr. *azur* (Eng. azure), from *lazulus*. So also It. *uscignuolo*, the nightingale, from *luscinia*, and It. *orbacca*, a berry, from *lauri-bacca*.

Another change that has been, perhaps, chiefly produced by the influence of the article, is the omission or insertion of the letter *f*. The article causes the initial consonants of feminine nouns (and in certain cases those of masculine nouns also) to be aspirated. Now aspirated *f* is wholly silent; and being omitted in pronunciation, it was, in the same circumstances, often omitted in writing. The Irish name of the River Nore affords an instance of this. Keating and O'Heerin write it Feoir, which is sounded Eoir when the article is prefixed (an Fheoir). Accordingly, it is written without the *f* quite as often as with it: The Four Masters mention it three times, and each time they call it Eoir. The total silence of this letter in aspiration appears to be, to some extent at least, the cause of its uncertain character. In the case of many words, the speakers and writers of Irish seem either to have inserted or omitted it indifferently, or to have been uncertain whether it should be inserted or not; and so we often find it omitted from words where it was really radical, and prefixed to other words to which it did not belong. The insertion of *f* is very common in the South of Ireland. (See O'Donovan's Grammar, p. 30.)

The following words will exemplify these remarks:—The ash tree was called both uinseann and ḟuinseann. With the *f* inserted it has given us the names of Funchadaun, Funchin, Funshinagh (Ḟuinseannaċ, abounding in ash trees), and Funshoge, all townlands, chiefly in the West of Ireland; and also that of the River Funcheon (the ash-producing river) in Cork. Without the *f* we have Unshinagh (Uinseannaċ, same as Ḟuinseanaċ), which is the name of seventeen townlands in the Northern and Western counties. From aill, a hill or cliff, we have a great number of names—such as Elphin, in Roscommon (aill-ḟinn, the rock of the limpid spring; Aillnaveagh, in parish of Omey, Galway (áill-na-ḃ-ḟiaċ, the ravens' cliff), &c. With the *f* prefixed, it is found in the names of about ninety townlands in different parts of Ireland, in the forms of Foil, Foyle, Fall, and Faul. Aill, I believe to be the most ancient form of this word, for Aıll-ꝼınn (Elphin) occurs in the Tripartite Life of St. Patrick. So with uaꞃ and ꝼuaꞃ, cold, and their derivatives, uaꞃan and ꝼuaꞃan, a cold spring, both of which frequently enter into names, in the anglicised forms of Oran and Foran. Fahan, on Lough Swilly, is sometimes written Ꝼaṫaın, and sometimes Aṫaın and Oṫaın, by the Four Masters.

The *f* has been omitted by aspiration in the names Lughinny, in parish of Killahy, Kilkenny, and Lughanagh, in parish of Killosolan, Galway (an Ꝼhluıċaıne, the wet land); and also in Ahabeg in parish of Carrigparson, Limerick (an Ꝼhaıṫċe-beaᵹ, the little green). The *f* has been affixed to the following words to which it does not radically belong; ꝼan for an, stay; ꝼoꞅcaıl for oꞅcaıl, open; ꝼıolaꞃ for ıolaꞃ, an eagle; ꝼaınne for aınne, a ring, &c.* It has also been inserted in Culfeightrin, the name of a parish in Antrim, which is properly Cuıl-eaċꞇꞃann, the corner or angle of the strangers. Urny in Tyrone is often called Furny, as in the record of Primate Colton's Visitation (1397), and the *f* is also prefixed in the Taxation of Down, Connor, and Dromore (1306), both showing that the corruption is not of recent origin.

I must notice yet another change produced by the article. When it is prefixed to a masculine noun commencing with a vowel, a *t* should be inserted between it and the noun, as aṫaıꞃ, father—an ꞇ-aṫaıꞃ, the father. In the case of a few topographical names, this *t* has remained, and has become incorporated with the word. For example, Turagh in parish of Tuogh, Limerick, *i. e.* an ꞇ-ıuḃꞃaċ, the yew land; Tummery in parish of Dromore, Tyrone, *i. e.* an ꞇ-ıomaıꞃe, the ridge; the original words are ıuḃꞃaċ and ıomaıꞃe. The best known example of this is Tempo in Fermanagh, which is called in Irish an-ꞇ-Iompoḋ Ꝺeıꞅıol, iompodh meaning turning, and deisiol, *dextrorsum*—from left to right. The place received its name from the ancient custom of turning *sun-ways*, *i. e.*, from left to right, in worship.

Under certain grammatical conditions, a *t* is also inserted before *s*, when the article is prefixed, in which case the *t* only is heard in pronunciation, the *s* not being sounded, though retained in correct writing. It is in consequence of this, that the word ꞅeaḃac a hawk (pron. *showk* in the South) is commonly disguised as *touk*, as in Monatouk in parish of Seskinan, Waterford (Moın-a'-ꞇ-ꞅeaḃaıc, the bog of the hawk); ꞅaᵹaꞃꞇ, a priest, frequently appears as *taggart* and *teggart*, as in the very usual name Ballintaggart, Baıle-an-ꞇꞅaᵹaıꞃꞇ, priest's town; Sıoḋán a fairy hill is often *teeane* and *teeaune;* Seaᵹal, rye, appears as *taggle* and *teggle;* ꞅeıꞅceann, a marsh, as *tesken;* and so with several other words.

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* See Dr. Reeves's "Primate Colton's Visitation," page 17.

II. *Interchange of* l, r, n, m.—The interchange of these letters is common in most languages; it would be easy, if necessary, to give examples from every language of Europe. For instance, the modern name Bologna is a corruption of the ancient Bononia; Palermo of Panormus; Amsterdam of Amstel-dam (the dam of the River Amstel); Rousillon of Ruscino, &c., &c.

The substitution of these letters, one for another, is also exceedingly common in Irish topographical names: and since this kind of corruption prevails in Irish as well as in English, the names were altered in this particular respect, quite as much in one language as in the other. *L* appears to have been a favourite letter, and the instances are particularly numerous in which it is substituted for the letter *r*. The word *Sruthair*, a stream, forms the whole or part of many names; and generally—but not always—the *r* has been changed to *l*, as in Shrule, Shruel, Struell, Sruveel, Sroohill, Sroolane, Commeenshrule, Abbeyshrule, all names of places in different parts of Ireland. In Abbeystrowry, the name of a parish in Cork, the *r* has been retained. *Biorar*, watercresses, is now always called in Irish *biolar*, in which form it enters into several names, as for example Aghaviller, a parish in Kilkenny (Aċaḋ-bıolaıꞃ, field of the watercresses); in Toberburr, however, in the parish of Finglas, Dublin, the original *r* is retained (Tobaꞃ-bıoꞃaıꞃ, watercress well). Lough Owel near Mullingar is written Loch Uair in the Irish Annals, but in the modern Irish it is always called *Loch Uail*, from which the present name has been derived. Rathlin, the name of an island on the coast of Antrim, and of another on the coast of Donegal, is corrupted from *Reachrainn* (which O'Donovan translates *sea rock*); and Loughbrickland in Down was anciently Loċ-Bꞃıcꞃenn, the lake of Bricriu, an Ulster chief of the first century.

N is also sometimes, though not often, changed to *l*, as in Lough Ennell in Westmeath, in Irish Loċ-Aınnınn, Ainninn's lake. Dingle in Kerry is a corruption of *Daingean*, a fortress, the full name being Daınᵹean-Uı-Chuıꞅ, the fortress of O'Cuis; and Castleconnell near Limerick is the castle of the O'Conaings, not of the O'Connells, as the present form of the name would indicate.

The change of *n* to *r* is one of frequent occurrence, an example of which is the name of Limerick, in Irish Luımne, which was originally the name of the lower Shannon, as Duıḃlınn was the name of the lower Liffey. Kilmacrenan in Donegal is properly Cıll-mac-Nenaın, the church of the sons of Enan. Killery harbour in Connemara is called at the present day in Irish, Caolḟaıꞃe, from which the present name is formed; but it should be Caolḟaıle, or, as it is written more fully by the Four Masters, Caolḟaıle-ꞃuaḋ, *i. e.* the reddish narrow-sea-inlet, a most appropriate name. In some of the Northern counties, the Irish-speaking people cannot without difficulty articulate the combinations cn and ᵹn, and in order to facilitate the pronunciation they change the *n* to *r*. There are about 45 townlands commencing with the word *Crock*, all in Ulster, except only a few in Connaught and Leinster, and a person unacquainted with the present peculiarity might be puzzled by this prefix, or might perhaps consider it an anglicised form of Cruaċ, a rick or piled up hill. But all these Crocks are really Knocks, disguised by the change of this one letter. In these counties also, the termination *nagrow* or *nagrew* is often found in townland names, as in Tullynagrow in the parish of Muckno, Monaghan; this termination has been similarly corrupted, Tullynagrow being properly Tulaiġ-na-gcno, the hill of the nuts.

The change of the *l* to *r* is not very common, but it is found in some names. Tirerrill, a barony in Sligo, is altered from Tir-Oiliolla, *i. e.* the district of Olioll son of Eochaidh Muighmheadhoin [*ōhy-moyvane*], monarch of Ireland in the fourth century. Dromcolliher in Limerick is properly Druim-collċuille, the ridge or hill of the hazel wood; and Ballysakeery, a parish in Mayo, is baile-easa-caoile, the town of the narrow cataract.

The change of *m* to *n*, or *vice versâ*, is of somewhat rare occurence. In Rathangan in Kildare, the first *n* should be *m*, the correct name being Raṫ-Imġain, Imghan's rath. *N* is changed to *m* in Kilmainham, *i. e.* St. Maighnenn's church; Boate calls it Kilmanan, which shows that it has been corrupted within the last 200 years. The same change has been made in Rathfarnham, *i.e.* Farannan's rath, and in Multyfarnham and Tyfarnham in Westmeath, the former signifying the mills (muilleann, a mill, pl. muilte), and the latter the house (tiġ) of Farannan or Arannan. The termination of the last four names seems to have been formed in imitation of the common English topographical postfix *ham*, home. In Moyacomb, the name of a parish in Wicklow, there is a genuine change of *n* to *m*, the Irish name being Maġ-da-ċon, the plain of the two hounds; and the same in Slieve Eelim the name of a mountain range east of Limerick city, which is Sliaḃ-Eiḃlinne, Evlin's mountain.

Several of the letter changes now examined have been evidently caused, or at least facilitated, by the difficulty of articulating the same letter twice in immediate succession, and this is a principle of considerable influence in corrupting language. It is easier to say Tirerrill than the right name *Tirellill*, Aghaviller than *Aghavirrer*, and so on, in several other cases.

III. *Change of* ċ, ġ, ḋ, *and* ṫ, *to* f. The guttural sound of *c* aspirated (ċ), as heard in loċ (lough), cannot be pronounced at all by a speaker of mere English, and as it constantly occurs in names, it is interesting to observe the different ways in which English substitutes are provided. When it comes in the end of words, it is often passed over altogether, being neither represented in writing nor in pronunciation, as in Ballymena (baile-meaḋonaċ, middle-town). Sometimes, both in the middle and end of words, it is represented by *gh*, which is often sounded by the English speaking natives, like the proper guttural ċ, as in Lough, Lughany, while those who cannot sound the guttural, pronounce it as *k* or *h* (*Lock*, *Luhany*); but if this *gh* occur at the end of words, it is commonly not sounded at all, as in Fermanagh, Kilnamanagh, &c. In the middle of words, its place is often supplied by *h* alone, as in Crohane, the name of a parish in Tipperary, and of several townlands (Cruaċán, a little rick or hill); and in many cases it is represented by *k* or *ck*, as in Foorkill in parish of Athenry, Galway (Fuar-ċoill, cold wood).

But there is a more remarkable change which this aspirate undergoes in common with three others. In many names, the sounds of the Irish aspirated letters ċ, ġ, ḋ, and ṫ, are converted into the sound of *f*; and this occurs so frequently as to preclude all supposition of mere accident. Ch is a hard guttural, as heard in the common word *lough* (loċ); ġ or ḋ (both which have the same sound) is the corresponding soft guttural, but in the end of Irish words, these aspirated letters are not sounded at all; ṫ is sounded exactly like English *h*.

The sound of ċ is changed to that of *f* in the following names. Knocktopher in Kilkenny, in Irish Cnoc-a-tóċair, the hill of the togher or causeway; Luffany, the name of two townlands in Kilkenny, an ḟliuċaine, the wet land; Clifden in Galway, Cloċán, a stone house: Lisnafiffy, the name of two townlands in Down, Lios-na-faiṫċe, the *lis* of the green. Coill, a wood, has the *c* usually aspirated when the word forms the second part of a compound term, and in these cases, it is often anglicised *field*, as in Cranfield, the name of a parish in Antrim, and of two townlands, one in Tyrone, and the other in Down, *i.e.* Cream-ċoill, wild garlick wood: Longfield, the name of 21 townlands in different parts of Ireland, but chiefly in the North, most or all of which are corrupted from the Irish Leam-ċoill, elm wood. So also the personal name Murphy, which is in Irish O'Murċaḋa; and it seems to be in conformity with the same principle, that the Irish croċta, an enclosure, corresponds with the English *croft*, same meaning.

In the following names, ġ or ḋ has been changed to *f*. Bruff in Limerick is properly bruġ, a mansion. The *brugh*, or mansion, that gave name to this place, still exists; it is an earthen fort near the town, called at the present day by the people, Lisín-a-bhroġa, the little *lis* of Bruff; there is also a townland named Bruff in parish of Aghamore, Mayo. Balief in parish of Clomantagh, Kilkenny, is baile-Aoḋa, Hugh's town; Muff, the name of two villages, one in Donegal, and the other in Derry, and of eight townlands, all in the northern half of Ireland, Maġ, a plain. In some cases, instead of the hard labial *f*, it is turned into the corresponding soft labial *v*, as in Lough Melvin, Loċ Meilġe, Meilghe's lake; Adrivale in parish of Drishane, Cork, Eadar-ġaḃal, between the [river] forks; Glasnevin, which is called Glas-Naoiḋen in Irish documents.

In the following names, ṫ has been changed to *f*. Kilclief, in Co. Down, which is called in the "Annals of the Four Masters," and other Irish documents, Cill-cleiṫe, the hurdle church, referring to the primitive church made of hurdles; Tiscoffin, a parish in Kilkenny, Tiġ-Scoiṫín, Scoithin's house or church; Cloonascoffagh, in the parish of Kilmacshalgan, Sligo, Cluain-na-scoṫaċ, the meadow of the flowers.

Sruṫán (diminutive of sruṫ), a streamlet, is often made Sruffane, especially in the Western counties, as in Ballytrofaun, in parish Kilshalvy, Sligo—baile-an-t-sruṫáin, the town of the streamlet. In Kildare the same word becomes Straffan, the name of a parish, which has also given name to one of the stations on the southern line of railway.

I believe that the greater number of the alterations noticed under this heading are attributable to the English language, but there are several instances of words and names corrupted similarly by the speakers of Irish. For example, the word ċuaiḋ, past tense of the verb teiḋ, go, is pronounced Fuaiḋ in the South; and O'Donovan, in one of his Derry letters, informs us, that the word maġ, a plain, is there pronounced in Irish "something between *mugh* and *muff*," thereby facilitating or suggesting its conversion into the present name, Muff. Bruff, in Limerick, is called by those who speak Irish, bruḃ na Deise, a corruption of the ancient name, bruġ na Ḋeise, though the word recovers its correct form in the name of the old fort—Lisín a' bhroġa.

Any one who had studied the English language and its letter changes, might however anticipate that the Irish gutturals would sometimes be converted into English *f*. Words transplanted directly from Irish, as might be expected, conform in many instances to the letter-changing laws of the English language; there are many illustrations of this, some of which I shall have occasion to refer to further on. Take as an example, names commencing with *knock*. In such English words as "knight," "knife," "knee," &c., the *k* sound is entirely omitted in pronunciation; but in the Anglo-Saxon originals *cnight*, *cnif*, *cneow*, both letters—the *c* hard and the *n*—were pronounced (Max Müller, "Lectures," 2nd series, p. 186). The Irish cnoc is subjected to the same law, for while both letters are heard in Irish, the anglicised form *knock* is always pronounced *nock*.

There is a similar compliance with English custom in the change of the Irish gutturals to *f*. The English language, though it has now no gutturals, once abounded in them, and in a numerous class of words the guttural letters are still retained in writing, as in *daughter*, *laughter*, *night*, *straight*, *plough*, &c. While in many such words the sound of the gutturals was wholly suppressed, in others it was changed to the sound of *f*, as in *trough*, *draught*, *cough*, *rough*, &c. It is a curious fact that the struggle between these two sounds has not yet quite terminated; it is continued to the present day in Scotland and the North of Ireland, where the peasantry still pronounce such words with the full strong guttural.

It will be seen, then, that when the Irish gutturals are corrupted to *f*, the change is made, not by accident or caprice, but in conformity with a custom already existing in the English language.

IV. *Interchange of* d *and* g.—The letters *d* and *g*, when aspirated (ḋ and ġ), are sounded exactly alike, so that it is impossible to distinguish them in speaking. This circumstance causes them to be, to some extent, confounded one with the other; in modern Irish, the ġ is very generally substituted for the older ḋ. In topographical names, this aspirated *g* is often hardened or restored (after the manner shown in page 226); and thus many names have been corrupted both in writing and pronounciation, by the substitution of *g* for ḋ. But as far as I have examined, I find only one example of the reverse—*d* for ġ.

The barony of Corcaguiny, in Kerry, should have been called *Corcaduinny*, for the Irish name is Corca-Dhuiḃne, *i.e.*, the race or progeny (*corca*) of Duibhne, who was grandson of Conaire Mór, monarch of Ireland in the third century. Corca-Dhuibhne was originally the name of a tribe; but, after a custom very common in Ireland, it was transferred to the territory they inhabited.

There are four townlands called Gargrim, in the counties of Donegal, Fermanagh, Leitrim, and Tyrone. The Irish name is Gearr-ḋruim, *i. e.* short ridge or hill, and it is correctly anglicised in Gardrum, the name of two townlands, one in Fermanagh, and the other in Tyrone. In exactly the same way was formed Fargrim, the name of two townlands, one in Fermanagh, and the other in Leitrim; it is in Irish Farḋruim or Forḋruim (outer ridge), in which form it appears in the Four Masters at A.D. 1153; in its correct anglicised form, Fardrum, it occurs in the name of two townlands, one in Fermanagh, and the other in Westmeath. Drumgonnelly in the parish and county of Louth, should have been called *Drumdonnelly*, from the Irish Druim-Dhonġaile, the ridge or hill of the Donnellys. Moneygold in the parish of Ahamlish, Sligo, is corrupted from Muine-Dhuḃaltaiġ, Dubhaltach's or Dudley's shrubbery. The townland of Rossdagamph, in parish of Inishmacsaint, Fermanagh, is Ros-da-ḋaṁ, the promontory of the two oxen. It was a mistake the reverse of this, that gave their present English name to the Ox mountains in Sligo. The Irish name in all our Annals, is Sliaḃ-ġaṁ (which probably means stormy mountain); but the natives, believing it to be Sliab-ḋaṁ, *i. e.* the mountain of the oxen, have accordingly perpetuated the present incorrect name.

V. *Insertion of* t *between* s *and* r.—The combination *sr* is one of comparatively rare occurrence in modern European languages; there is not a single word in English, French, German, Greek, or Latin, beginning with it, though many of their words are undoubtedly derived from roots commencing with these two letters.

The Irish language has retained this combination, and in the Irish dictionaries, a considerable number of words will be found commencing with *sr*. Of these, there are, so far as I know, only four that enter *often* into topographical names. These are sráid, a street; sraċ, a holm or inch—the lowland along a river; srón, literally a nose, but in a secondary sense, applied to points of hills, promontories, &c.; and sruċ, a stream, with its derivative sruċair, and diminutives sruċán and sruilín. It was not to be expected that the English language, which within its own domain does not admit of the union of *s* and *r*, should receive these names in all cases without alteration. Of the modern townland names containing the four words just named, the *sr* has been retained in less than half; in about forty or fifty, it has been changed to *shr*, and in all the rest it has been corrupted by the insertion of a *t*. There are about 170 modern names commencing with *str*, and many more containing these letters intermediate. In all these, with hardly an exception, the *t* is a late insertion; for although we have words in Irish commencing with *str*, there are no names derived from them, except perhaps about half a dozen. The insertion of a *t* is one of the expedients for avoiding the combination *sr*, which is found in several languages, and which has been in operation from the earliest times. We find it, for instance, in the O. H. German *stroum* (Eng. stream), and in the name of the well-known Thracian River Strymon, both of which are derived from a Sanscrit root *sru*, meaning *to flow*.*

A few names will illustrate these remarks. In Srugreana in parish of Killinane, Kerry (Sꞃuṫ-ᵹꞃıanaċ, gravelly stream), and in Srananny in parish of Donagh, Monaghan (Sꞃaṫ-an-eanaıᵹ, the strath or holm of the marsh), the initial *sr* has been retained. In Shrule (Sꞃuṫaıꞃ), the name of a town in Mayo, and of seven townlands in different counties, it has been changed to *shr;* and also in Shronagree, in the parish of Skull, Cork (Sꞃon-na-ᵹ-cꞃoıḋe, the nose or point of the cattle). In the following names, a *t* has been inserted. Stradbally is the name of several townlands and villages; the Irish name is Sꞃaꝺḃaıle, *i. e.* street town, from ꞅꞃáıꝺ and baıle, and the word originally meant a town consisting of one long street, undefended by either walls or castle. Strancally on the Blackwater, in parish of Kilcockan, Waterford, the well-known seat of the Desmonds, is in Irish Sꞃón-caıllıġe, the hag's nose or promontory. Ardstraw, in Tyrone, is Aꞃꝺ-ꞅꞃaṫa, the height of (or near) the srath or river bank; and Strabane, also in Tyrone, Sꞃaṫ-bán, white srath. Struell, in the parish and county of Down, is Sꞃuṫaıꞃ, a streamlet, but this word is more commonly anglicised Shrule.

This corruption—the insertion of *t*—is found more or less all over Ireland, but it prevails more in the Northern counties than anywhere else. In Ulster, the combination *sr* is scarcely admitted at all; of about 170 townland names in all Ireland, commencing with these two letters, there are only twelve in this province, and these are wholly confined to Donegal, Fermanagh, and Monaghan.

VI. *Addition of* d *after* n, l, *and* r; *and of* b *after* m.—The most extensive agency in corrupting language is contraction, *i. e.* the omission of letters; first, in pronunciation, and afterwards in writing. This is what Max Müller calls phonetic decay, and he shows that it results from a deficiency of muscular energy in pronunciation, in other words, from laziness. There are cases, however, in which this principle seems to be violated, that is, in which words are corrupted by the *addition* of anomalous letters. In English, for instance, a *d* is often added after *n*, and in Greek after both *n* and *l*; as in Eng. *thunder* from A.-Sax. *thunor*; *cinder* from Lat. *cinis*, *cineris*, &c.; and in Greek, *anēr*, gen. *andros*, &c. This tendency in English is also noticed by Lhuyd in his "Archæologia" (p. 9). Another corruption similar to this, which is found in several languages, is the addition of *b* after *m*; as in Eng. *slumber* from A.-Sax. *slumerian*; Fr. *nombre* from *numerus*; Lat. *comburo*, from *com* (*con*) and *uro*; Gr. *gambros* for *gamros*, &c. Max Müller shows, however, that the insertion of these letters is due to the same laziness in pronunciation that causes omission in other cases.*

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* See Mr. Whitley Stokes's "Irish Glosses;" and Dr. W. K. Sullivan's Translation of Ebel's "Celtic Studies."

These corruptions are very frequent in Irish names, viz.:—the letter *d* is often placed after *n* and *l*, and sometimes after *r*; and the letter *b* after *m*. In Oneilland, the name of a barony in Armagh, the *d* is a mere excrescence, for the Irish name is Ua Niallain, *i. e.* the territory of the Hy Niallain, a tribe descended and named from Niallan, fourth in descent from Colla Da Chrioch. The same corruption is found in the following, as well as in many other names: Terryland, near Galway (Tir-oiléin, the district of the island); Killeshandra, in Cavan (Cill-a-t-sean-ráṫa, the church of the old rath, because the original church was built within the inclosure of an ancient rath); Tandragee, the name of a town in Armagh, and of several townlands, chiefly in the northern counties (Tóin-re-gaoiṫ, *podex ad ventum*); Rathfryland, in Down (Raṫ-Fraoileann, Freelan's rath); Tullyland in parish of Ballinadee, Cork (Tulaiġ-Eileáin, Helena's hill).

D is added after *l* in the word "field," when this word is an anglicised form of coill, a wood, as in Longfield, Cloncraffield, &c., which names have been already examined. The same corruption is found in the ancient Welsh personal name, Gildas, and in the Irish name Mc Donald, which are more correctly written Gillas and Macdonnell. Sometimes the hard dental *t*, instead of the soft *d*, is placed after *l*, as in Carrigaholt in Clare, in Irish Carraig-an-ċoblaiġ, the rock of the such as Castlecomer in Kilkenny—the castle on the *comar* or confluence.

All these changes were, I believe, made in English, but in the Irish language there was once a strong tendency in the same direction. In what is called middle Irish (from about the 10th, to about the 15th, century), the custom was very general of using *nd* for *nn*. For instance the word *cenn* (a head) is old Irish, for it is cited in this form by Zeuss from MSS. not later than the beginning of the ninth century; but in middle Irish MSS. it is usually written *cend*. In all such words, however, the proper termination is restored in modern Irish; and so strong was this counter-current, that the *d* was swept away not only from words into which it was incorrectly introduced, but also from those to which it properly and radically belonged. The middle Irish words Aıꝼꝼꞃenꝺ (the Mass), and muıleanꝺ (a mill), are spelled correctly with a *d*, for they are derived from Lat. *offerenda*, and *molendinum*; but in modern Irish, they are always spelled and pronounced, Aıꝼꞃıonn, and muıleann.

Some of the words and names cited under this section, afford a curious example of the fickleness of phonetic change, and at the same time, of the regularity of its action. We find words spelled in Old Irish with *nn*; in Middle Irish, a *d* is introduced, and the *nn* becomes *nd*; in Modern Irish, the *d* is rejected, and there is a return to the Old Irish *nn*; and in modern anglicised names, the *d* is reinstated, and *nd* seems to remain in final possession of the field.

There is a corruption peculiar to the Northern and North-Western counties, which is very similar to the one now under consideration, namely, the sound of aspirated m (ṁ = Eng. v) is often represented in the present names by *mph*. This mode of spelling is probably an attempt to represent the half nasal half labial-aspirate sound of ṁ, which an ear unaccustomed to Irish finds it very difficult to catch. Under the influence of this custom, *damh*, an ox, is converted into *damph*, as in Derrydamph in parish of Knockbride, Cavan (Ꝺoıꞃe-ꝺaṁ, the oak grove of the oxen); *creamh*, wild garlic, is made *cramph*, as in Annacramph, in parish of Grange, Armagh (Eanaċ-cꞃeaṁa wild garlic marsh); *sceamh*, the polypodium or wall fern, becomes *scamph*, as in Drumnascamph in parish of Clonduff, Down (Ꝺꞃuım-na-ꞅceaṁ, the ridge or hill of the wall fern).

VII. *The letter* s *prefixed to* ꞇeaċ *or* ꞇıᵹ, *and* leaċꞇ.—The Irish word ꞇeaċ, which is also written ꞇıᵹ, means primarily a house, but it was also often applied to a church. In both senses it enters extensively into topographical names all over Ireland, in the anglicised forms of *Ta, Tagh, Tee, Ti, Ty,* &c. In some of the Eastern counties, this word is liable to a singular corruption, noticed by Dr. Reeves and Dr. O'Donovan, viz. the Irish *Ta* or *Ti* is converted into *Sta* or *Sti*, in a considerable number of names, of which the following are examples. Stillorgan is in Irish Ꞇıᵹ-Loꞃcaın, Lorcan's or Laurence's house; Stabannon in Louth ought to be Tabannon, from Ꞇeaċ-banáın, Bannan's

Connaught. In Derrynanool in parish of Marshalstown, Cork (Doire-na-n-aḃall, the grove of the apples), the ḃ is not heard, while it is fully sounded in Avalbane, in parish of Clontibret, Monaghan (Aḃall-bán, white orchard), and in Killavil, in parish of Kilshalvy, Sligo (Cill-aḃaill, the church of the apple tree).

In certain positions aḋ is sounded like Eng. *eye*, in the South; thus Laḃar, a [river] fork, is made *lyre*, and in this form it constitutes the whole or part of more than sixty townland names, nearly all in Munster. More northerly the same word appears as *lerr* or *lear*, as in Knocknalear, in parish of Clones, Fermanagh (Cnoc-na-laḃar, the hill of the forks), and the river Lerr in Kildare, which would be called Lyre in the south. So Claḋ, a dyke or mound of clay, is anglicised *cly* in the South, and *claw* or *cla* in the North, and in both forms, enters extensively into names.

Aḋ in the termination of words is sounded like *oo* in Connaught; thus madaḋ, a dog, is anglicised *maddoo* in Carrownamaddoo, the name of three townlands in Sligo—while it is made *vady* in Limavady in Derry (Leim-a-ṁadaiġ, the dog's leap, which is properly the name of the cataract near the town).

One of the most distinctly marked provincial peculiarities, so far as names are concerned, is the pronunciation that prevails in Munster, of the final ġ, which is sounded there like the English hard *g* in *fig*. Great numbers of local names are influenced by this corruption. Ballincollig, near Cork is baile-an-ċullaiġ, the town of the boar, and would be better anglicised *Ballinculty*. Ballintannig in parish of Ballinaboy, Cork, is baile-an-t-seanaiġ, the town of the fox; and Ballinhassig, same parish, is baile-an-easaiġ, the town of the cataract. The present name of the river Maigue in Limerick is formed on the same principle, its Irish name being Maiġ, that is, the river of the plain. The greater number of Munster names ending in *g* hard, are illustrations of this peculiar pronunciation.

It is, no doubt, owing to a difference in the way of pronouncing the original Irish words, that Cluain (an insulated bog meadow), is sometimes in modern names made *cloon*, sometimes *clon*, and occasionally *clone*; that Dún (a fortified residence), is in one place spelt *doon*, in another *dun*, and in a third *down*; that in the neighbourhood of Dublin, *Bally* is shortened to *Bal*, in Donegal *Rath* is often made *Rye* or *Ray*, and in Wexford *Tober* is sometimes changed to *Gibber*, &c., &c.

IX. *Irish Names with English Plurals.*—It is very well known that topographical names are often in the plural number, and this peculiarity is found in the nomenclature of all countries. Sometimes in transferring foreign names of this kind into English, the original plurals are retained, but much oftener they are rejected, and replaced by English plurals, as in the well-known examples, Thebes and Athens.

Great numbers of Irish topographical names are in like manner plural in the originals, and there is considerable diversity in anglicising them. Very often the original terminations are retained, as in Boolteeny in parish of Kilmore, Tipperary (buailtíniḋe, little *booleys* or dairy places]; Milleeny, in parish of Ballyvourney, Cork (Millíniḋe, little hillocks, from meall, a hillock).

Oftener still, the primary plural inflection is rejected, and its place supplied by the English termination. Fews is the name of a parish in Waterford, and of two baronies in Armagh; there is also a district in Roscommon called "The Fews or Faes of Athlone." The word means "woods," and the two latter places are called by the Four Masters Feaḋa, which is the plural of Fioḋ, a wood. Keeloges is the name of about 26 townlands scattered all over Ireland; it means "narrow ridges or plots," and the Irish name is Caológa, same meaning. Carrigans is a common name in the North, and Carrigeens in the South; it is the anglicised form of Carraigíniḋe, little rocks. Daars, a townland in parish of Bodenstown, Kildare, means "oaks" from Dáirġe, plural of Dair, an oak. So Mullans and Mullauns, from Mulláin, little flat hills; Derreens from Doiríniḋe, little *derrys* or oak groves; Ards and Ardes, from Arda, heights; Bawnoges from Bánóga, little green fields, &c.

In many names, the Irish plural form is wholly or partly retained, while the English termination is superadded: these double plurals are very common. Glenties in Donegal, is called in Irish na Gleanntaiḋe, "the glens" (sing. gleann). Glentie, which is the proper anglicised form, would of itself mean "glens" without the addition of the *s*, which makes it a double plural. The place receives its name from its situation at the head of "The glens of Boylagh." Killybegs, the name of a village in the same county, and of several other places in different parts of Ireland, is in Irish Cealla-beaga, little churches. The plural of Cluain (an insulated meadow) is Cluainte, which is anglicised *cloonty*, a common townland name. With *s* added, it becomes Cloonties, the name of some townlands, and of a well-known district near Strokestown, Roscommon. This last is called Cloonties, because it consists of 24 townlands, all whose names begin with the word "cloon."

NAMES PARTLY OR WHOLLY ENGLISH.

X. *Translated Names.*—Whoever examines the Index list of townlands will perceive, that while a vast preponderance of the names are obviously Irish, a very considerable number are plain English words. These English names are of three classes, viz., really modern English names, imposed by English-speaking people, such as Kingstown, Castleblakeney, Charleville; those which are translations of older Irish names; and a third class to which I shall presently refer. With the first kind—pure modern English names—I have nothing to do; I shall only remark that they are much less numerous than might be at first supposed.

A large proportion of those townland names that have an English form, are translations, and of these I shall give a few examples. Saintfield, in Down, is a correct equivalent of the old name Tonaghneeve (Ꞇaṁnaċ-naoṁ), which means the field of the saints. Watergrasshill in Cork, is universally called by those speaking Irish, Cnocan-na-bıolꞃaıᵹe, the hill of the watercresses. The Irish name of Cloverhill in parish of Kilmacowen, Sligo, is Cnoc-na-ꞅeamaꞃ, the hill of the shamrocks. Skinstown in parish of Rathbeagh, Kilkenny, is a translation of Baıle-na-ᵹ cꞃoıceann, and Nutfield in parish of Aghavea, Fermanagh, is correctly translated from the older name Aghnagrow (Aċaḋ-na-ᵹ-cno.)

Among this class of names, there are not a few incorrectly translated. All such false translations are the result of confounding Irish words, which are nearly alike in sound, but different in meaning. Freshford in Kilkenny should have been called *Freshfield*, which is the correct equivalent of its Irish name Aċaḋ-úꞃ, while its present name is a translation of Aṫ-úꞃ. The Irish name of Strokestown in Roscommon, is not baıle-na--m-búılle, as the present incorrect name would imply, but béal-aṫa-na-m-búılle, the ford (not the town) of the strokes or blows. In Castleventry, the name of a parish in Cork, there is a strange attempt at preserving the original signification. Its Irish name is Caıꞅleán-na-ᵹaoıṫe, the castle of the wind, which has been made Castleventry, as if *Ventry* had some connexion in meaning with *ventus*.

In Meath great numbers of townland names end in the word *town;* and those names derived from families are almost always translated so as to preserve this termination, as Drakestown, Gernonstown, Cruicestown, &c. But several names are anglicised very strangely, and some barbarously, in order to force them into compliance with this custom. Thus Teltown is the modern form of the ancient Tailltean; the Irish name of Mooretown, in parish of Ardcath, is baıle-an-ċuꞃꞃaıᵹ, the town of the *moor* or marsh; Crannaghtown, in parish of Balrathboyne, is in Irish baıle-na-ᵹ-cꞃannaċ, the town of the trees; Tullaghanstown, in parish of Clonmacduff, is baıle-an-ꞇulċaın, the town of the hillock, &c.

Many names again, of the present class, are only half translations, one part of the word being not translated, but merely transferred. The reason of this probably was, either that the unchanged Irish part was in such common use as a topographical term, as to be in itself sufficiently understood, or that the translators were unable to find an equivalent for it in English. The name of Dalkey is a familiar example—the first part, *Dalk*, is merely the Irish ꝺealᵹ, a thorn, and the second part, *ey*, is the Danish equivalent of Inıꞅ, an island; the full Irish name was Ꝺeılᵹınıꞅ, *i. e.* thorny island. In the parish of Ballycarney, Wexford, there is a townland taking its name from a ford, called in Irish Scaıꞃḃ-an-bhꞃeaṫnaıᵹ, Walsh's *scariff* or shallow ford, and this, with an obvious alteration, has given name to the barony of Scarawalsh, Turkhead in parish of Aghadown, Cork, means, not the head of a *Turk*, but the head of a boar; its original name being the same as that of the town of Kanturk (Ceann-tuirc, *i. e.* boar's head). In Cargygray, in parish of Annahilt, Down, *gray* is a translation of riaċa, and *cargy* is the Irish cairge, rocks; the full name is cairge-riaċa, grey rocks. The Irish name of Curraghbridge, near Adare in Limerick, is Droiċet-na-corra, the bridge of the weir or dam, and it is anglicised by leaving corra nearly unchanged, and translating droiċet to *bridge*.

XI. *Irish names simulating English forms.*—The non-Irish names of the third class, already alluded to, are in some respects more interesting than those belonging to either of the other two. They are apparently English, but in reality Irish; and they have settled down into their present forms, under the action of a certain corrupting influence, which often comes into operation when words are transferred (not translated) from one language into another. It is the tendency to convert the strange word, which is etymologically unintelligible to the mass of those beginning to use it, into another that they can understand, formed by a combination of their own words, more or less like the original in sound, but almost always totally different in sense. This principle exists, and acts extensively in the English language, and it has been noticed by several writers—among others by Latham, Dr. Trench, and Max Müller, the last of whom devotes an entire lecture to it, under the name of "Popular Etymology." These writers explain by it the formation of numerous English words and phrases; and in their writings may be found many amusing examples, a few of which I shall quote. It is designated by Latham "words of foreign, simulating a vernacular origin," and I have borrowed from him the word "simulating" in the heading of this section.

The word "beefeater" is corrupted from *buffetier*, which was applied to a certain class of persons, so called, not from eating beef, but because their office was to wait at the *buffet*. Shotover Hill, near Oxford, a name which the people sometimes explain by a story of Little John *shooting* an arrow *over* it, is merely the French Château Vert. The tavern sign of "The goat and compasses," is a corruption of the older sign-board "God encompasseth us;" "The cat and the wheel" is "St. Catherine's wheel;" Brazenose College, Oxford, was originally called Brasen-huis, *i. e.* brew-house, because it was a brewery before the foundation of the college; and "La rose des quatre saisons" becomes "The rose of the quarter sessions," &c., &c.

This principle has been extensively at work in corrupting Irish names—much more so indeed than I had believed before commencing to write this paper. I have collected a long list of illustrative names, which might be much extended by a further search, but only a very small portion can be presented in this paper.

The best anglicised form of coill, a wood, is *kill* or *kyle*; in many names, however, chiefly in the North of Ireland, it is changed to the English word *field*. Cranfield, the name of three townlands in Down, Antrim, and Tyrone, is in Irish Creaṁ-ċoill (pr. *crav-whill*),* *i. e.* wild garlick wood. Leaṁ-ċoill (pr. *lav-whill*), a very usual name, meaning "elm-wood," is generally transformed into the complete English word Longfield, which forms the whole or part of a great many townland names. The conversion of ċoill into field seems a strange transformation, but every step in the process is accounted for, by principles already examined in this paper, namely, the conversion of ċ into *f*, the addition of *d* after *l*, and the alteration of the Irish into an English word. There are many townland names in the South, as well as in the North, in which the same word coill is made *hill*. Who could doubt but that Coolhill in the parish of The Rower, Kilkenny, means the cool or cold hill; or that Boyhill in the parish of Aghavea, Fermanagh, is the hill of the boys? But the first is really cúl-ċoill (pr. *Coolhill*), back wood, and the second buiḋe-ċoill (pr. *bwee-hill*), yellow wood. So also in Scaryhill, Cullohill, Dunhill, and many others.

Móintean (pr. *mone-thaun*), boggy land, and Móintín (*mone-theen*), a little bog, are in the South, very generally anglicised *mountain*, as in Ballynamountain, Kilmountain, Coolmountain, &c., all townland names; and in both North and South, uaċtar, upper, is frequently changed to *water*, as in Ballywatermoy, Wateresk, &c. There is a parish in Antrim called Billy, a townland in parish of Kinawly, Fermanagh, called Molly, and another in parish of Ballinlough, Limerick, with the more ambitious name of Cromwell; but all these sail under false colours, for the first is bile (*billĕ*), an ancient tree, the second Málaiġe (pr. *mauly*), hill-brows, or braes, and Cromwell is nothing more than Crom-ċoill (pr. *Crumwhill*), stooped or sloping wood. The word bile is in other instances transformed into the fashionable *ville* or *villa*, as in Munville, in parish of Aghalurcher, Fermanagh (Muine-ḃile, the shrubbery of the ancient tree), and Bauravilla in parish of Caheragh, Cork, the *barr* or hill top of the tree.

There are several places in Tipperary and Limerick called by the Scriptural name Mountsion; but *Mount* is only a translation of cnoc, and *sion*, an ingenious adaptation of siḋeán (pr. *sheeawn*), a fairy mount, the full Irish name being Cnoc-a'-t-siḋeán, fairy-mount hill. No English word could be plainer than Lowertown, a name of frequent occurrence; stripped of its English dress, however, it turns out to be Luḃġortán (pr. *looartaun*), an herb-garden; the same word is in other places anglicised Lorton, Lurton, Luffertane, &c. There is a parish in Roscommon, called anciently, Diseart-Nuaḋain, Nuadhan's desert or hermitage, and in the corrupt modern Irish, Ister-Nuadhain (pr. *Isternooan*); and this has been metamorphosed in the strange name of Eastersnow. Islafalcon in parish of Ardtramon, Wexford, is not what it appears to be, the island of the falcon, but Oıleán-a'-ḃocáın (pr. *ilaun-a-fuckaun*), the island or river-holm of the buck goat; and Lisnamulligan, in parish of Clonduff, Down, is not Mulligan's *lis*, but Lıoꞅ-na-ḃ-ꝼaoıleaᵹán (pr. *lisnaveelagaun*), the *lis* or rath of the sea gulls.

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* I have given the pronunciation (as nearly as English letters can represent it) of most of the Irish words in this section; for without it, a reader, not understanding Irish, would be unable to catch the point in the different transformations.

So also braighid (a gorge) has been changed to *broad*, chonaidh (an inflection of conadh, firewood) to *honey*, Gabhailin to *Golden*, Botharliath to Birdlee, 'n Iubhrach to *Newrath*, Greagraidhe to *The Gregories*, Both-iseall to Bush-hill, &c., &c.

Nearer home, however, we have a good example of this process in the name of the Phœnix Park. This word Phœnix (as applied to our park), is a corruption of Fıonn-uıꞅᵹ' (pr. *feenisk*), which means clear or limpid water. It was originally the name of the spring well near the Phœnix pillar, situated just outside the wall of the Viceregal grounds, behind the gate lodge, and which is, I believe, the head of the stream that supplies the ponds near the Zoological Gardens. No name could be more characteristic for this well than "Fionn-uisg," for the water is perfectly transparent. The name has given origin to the figure of the phœnix on the top of the pillar. It is proper to remark that this name Fıonn-uıꞅᵹ' is common through the country, in the anglicised form *Finisk*, and was originally applied to small, clear, sparkling streams. There is a river Finisk, for example, joining the Blackwater about three miles below Cappoquin.

But I shall not dwell further on this portion of the subject; it would be an endless task, and totally incompatible with the limits of a single paper, to pursue it through all its ramifications; I trust, however, that enough has been said, and a sufficient number of examples given, to show how extensively Irish names are corrupted by this tendency to make Irish words simulate English forms.

I have now examined eleven different sources of corruption and change, in Irish names, and I have selected these, because, so far as I am aware, they are the most striking and important, as well as the most extensive in their influence. There are other letter changes of a less violent character, such as those caused by metathesis, grammatical inflection, &c., which I have not thought sufficiently important to notice. The interchange of hard and soft mutes (or *tenues* and *mediæ*) is extremely common, but this too, as not causing considerable obscuration of the names, I shall dismiss with a single remark. In the formation of modern English names from ancient Irish, the change from hard to soft is comparatively rare, while the reverse change, from soft to hard, occurs very frequently. Dulane, near Kells, is an example of the former, its ancient name, as spelled by the Four Masters, being Cuılen or Culán, *i. e.* the little *tulach* or hill; as examples of the latter, it will be sufficient to mention the frequent change of ꝺuḃ (black) to *duff*, ᵹaꞃḃ (rough) to *gariff*, caꞃꞃaıᵹ (a rock) to *carrick*, &c., in the two former of which the sound of *v* is converted to that of *f*, and in the last the sound of *g* (in *got*) is changed to that of *k*. There are also corruptions of an exceptional and unexpected character, which

I have not been able to reduce to any principle, but I shall not dwell on them, as the object of this paper is not so much the examination of individual names, as the development of general laws.

It very often happens that different Irish words, in consequence of having some resemblance to each other in sound, assume the same form in English. Coıll, a wood, often becomes *kill*, which is the usual anglicised form of cıll, a church; and on the other hand, cıll is sometimes (especially in Munster) made *kyle*, which is the best and most common English form of coıll. In Kilmallock, the first syllable means a church, in Kilmore (a barony in Cork), it is "a wood; in Kylebeg (parish of Aglishcloghane, Tipperary), Kyle is "church," and in Kylebrack (parish of Leitrim, Galway), "a wood." Aughrim, Aughnacloy, and Aughanure, all begin with the same syllable *Augh;* but in the first, it means a horse (eaċ), in the second a ford (aṫ), and in the third a field (aċaḋ). Bally is usually the Irish baıle, a town or townland, as in Ballymote; but it is also very frequently the anglicised representative of béal-aṫa, ford (lit. *ford-mouth*) as in Ballyshannon. In Kilduff, the last syllable is the Irish duḃ, black, while in Clonduff (a parish in Down), it is daıṁ, the genitive of daṁ, an ox.

In such names as these, it is impossible to determine the etymology with certainty, without knowing either the Irish pronunciation, or the original orthography; and there are many names of this class whose meanings are still unsettled, in consequence of having lost both history and pronunciation. The fact here established, that the same word often represents different Irish roots, demonstrates the folly of attempting to explain the meanings of names merely from their modern forms.

Notwithstanding the variety of disturbing causes, and the great number of individual names affected by each, only a small proportion of the whole are corrupted, the great majority being, as already stated, anglicised correctly or nearly so. When it is considered that there are more than 60,000 townlands in Ireland, and when to the names of these are added the countless names of rivers, lakes, mountains, &c., it will be seen that even a small fraction of all will form a number large enough to give sufficient play to all the corrupting influences enumerated in these pages.

There is no part of Irish antiquities in which writers have indulged in so much useless speculation, as in the interpretation of Irish topographical names. Almost all our tourists' hand-books, county histories, topographical dictionaries, &c., abound in etymologies of names. But if we leave out of the question a few topographical descriptive works of a superior class, published within the last few years, it may be safely asserted, that these interpretations are, generally speaking, false and worthless. Instead of seeking out the ancient forms of the names in authentic Irish documents, or ascertaining their proper pronunciation from the people of the localities, and making allowance when necessary for the usual letter changes, writers of this class, ignoring both authority and analogy, invented original forms that the names never had, and interpreted them, each according to his own fancy, or to lend plausibility to some favourite theory. There are few localities of any note in the whole country, that have not been subjected by one writer or another to conjectural explanations of this kind; of these it may not be uninstructive nor out of place to subjoin a few examples.

Bangor (in Down), has been generally supposed to come from Bán-chora, meaning "white choir," which name, Harris states, was derived from the elegance of its lime and stone building. This building was erected by St. Malachy in the 12th century, and Dr. Reeves remarks on the absurdity of accounting for the name Bangor, which existed in the 6th century, by a building which was not erected till the 12th. The true name is beannċoir, which means horns, gables, peaks, or pointed rocks; and this root, under slightly modified forms, enters frequently into names in different parts of Ireland. Thus Banagher, the name of a town in King's County, and of seven townlands in other counties; Movanagher in parish of Kilrea, Londonderry; Drumbanagher in parish of Killevy, Armagh, and several other places.

Clonmacnoise has been often explained "The retreat of the sons of the noble," a name which it was thought to have received, either because the place was anciently very much frequented by the nobility, or because it was the burial place of so many kings and chieftains. But the proper form of the name, as used in the Annals, is Cluain-Mic-Nois, which means "the *cloon* or insulated meadow of the son of Nos."

Askeaton in Limerick is made Eas-cead-tinne, in a well-known modern topographical work on Ireland; the writer explains it "The cataract of the hundred fires," and adds, "the fires were probably some way connected with the ritual of the Druids, the ancient Irish Guebres." The name, however, is Eas-Gephtine, which simply means the cataract of Gephtine, some old pagan chief. The cataract is where the Deel falls over a ledge of rocks near the town. I may remark here, that great numbers of these fanciful derivations were invented to prove that the ancient Irish worshipped fire. Balla, in Mayo, is explained by Vallancey "The fire of fires;" but we are told in the life of St. Mochua, the founder, published by Colgan, that the place, which had previously been called Ros-Dairbhreach, received the name of Balla, from the walls (balla), with which St. Mochua enclosed the wells of his religious establishment. Aghagower, in the same county, Vallancey also explains "Fire of fires;" the original name, however, is Achadh-fobhair, in which, as O'Donovan remarks, there is not a word signifying fire at all, its meaning being "the field of the spring," from a celebrated well, still in existence, and now known by the name of St. Patrick's well. Neither does the present form of the name—Aghagower—mean "Fire of fires," but a very different thing, "the field of the goat."

Smith in his History of Cork, states that the barony of Kinalmeaky means "the head of the noble root" from *cean*, head, *neal*, noble, and *meacan*, a root. The true form of the name, however, is Cinel-mBece, which was originally the name, not of the territory, but of the tribe that inhabited it, and "means the descendants (*cinel*) of Bece," who was the ancestor of the O'Mahonys.*

In Seward's Topographical Dictionary, it is stated that Baltinglass (in Wicklow) "is derived from *Beal-tinne-glas*, or *the fire of Beal's mysteries*, the fires being lighted there by the Druids in honour of the sun;" and the writer of a Guide to Wicklow (Curry, Dublin, 1834), says that it is "Bal-teach-na-glass, or *the town of the grey houses*," and he adds, "certainly the appearance of them bears us out in this." This is all pure invention: neither of the original forms here given is the correct one, and even if it were, it would not bear the meaning assigned, nor indeed any meaning at all. In ancient documents, the name is always given Bealach-Chonglais, which means the pass or road of Cuglas, who was a historical personage connected with the locality.

Carnsore Point, in Wexford, is called by Ptolemy, Hieron Akron, *i. e.*, the Sacred Promontory; and Camden ("Britannia," Ed. 1594, p. 659), in stating this fact, says, he has no doubt but that the native Irish name bore the same meaning. This conjecture seems fair enough, but the reason he gives for his conviction is a very unfortunate one. He states that the name of Bannow, a town situated not far from the promontory, where the English made their first descent, signifies "sacred" in the Irish language. The Irish verb beannuiġ means "to bless," and its participle is beannuiġṫe, "blessed:" but this has no connexion in meaning with Bannow, which is nothing more than the anglicised form of banḃ, a sucking pig. The harbour where Robert Fitzstephen landed, was called in Irish Cuan-an-ḃainḃ, *i. e.* the harbour of the *bonnive*, or young pig, and Bannow has perpetuated the latter part of the name.

These examples may serve as a specimen of what some years ago passed as learning. There was a time, and that not far distant, when whole theories regarding the social condition or religious belief of the early inhabitants of this country were built upon, or mainly supported by fanciful and silly etymologies. This practice has done much mischief, by helping to impress the scholars of other countries, and even of

The Rev. John F. Shearman (with permission of the Academy) read the following paper:—

On some Inscribed Stones at Killeen Cormac, near Dunlavin.

Among the many places and objects of antiquarian interest in the neighbourhood of Dunlavin, is the ancient cemetery of Killeen Cormac, lying to the south-west of Dunlavin, and distant from it about three miles. It is situated on the lands of Colbinstown, in a detached portion of the parish of Davidstown, in the barony of E. Narragh and Reban, county of Kildare. This interesting spot lies in a valley of picturesque character, traversed by the River Griese, here separating Wicklow from Kildare, and the diocese of Leighlin from that of Glendalough. This valley is diversified by insulated mounds or eskars, which, as they still retain their Irish names, and being connected with the history of the locality, a description of them may not be deemed foreign to the subject of this paper.

On the left bank of the Griese, in the parish of Ballynure, is a long eskar, called Bullock Hill, the legend of which will hereafter appear. On the right bank is another elevation, called Cnoc Bunnion,[*] by way of opposition to Bullock Hill. Beyond this is another eskar, the highest of the group, called Rathown Beck, having on its summit a well-preserved moat, of large dimensions. A small stream, called the Srughan, *i. e.* little river, flows under it, and joins the Griese in the vicinity. Another mound lies between this and Cnoc Bunnion, which is the site of the old cemetery of Killeen Cormac, the subject of this paper. This eskar is of oval form, its major axis lying nearly east by west. It is occupied by the remains of three concentric enclosures, dividing the surface of the slopes into as many steps or terraces, the highest of which, on the western end, is fashioned into a moat or rath, in which is a square depression, excepting which there are no direct indications of the site of the church.

A great quantity of large stones lie about, and plainly indicate that a building of primitive design, and of Cyclopean structure, must have once occupied the summit of this mound. These terraces are now in a very ruinous state; but sufficient indications remain to convey a fair idea of their original construction. On the east side the outline of the middle terrace is well preserved by the large flat stones, set on their edges, against the bank; and on the western end, under the moat, the same construction occurs, but in a more dilapidated state, the stones having fallen from their upright position through the lateral pressure of the banks which they sustained. These flags are of greenstone, and quarries producing such exist on the Hill of Uske, in the vicinity.

Pillar stones, fragments of what may have been rude crosses, of coarse-grained granite, lying scattered about, with the rocks which formerly supported the terraces, give to Killeen Cormac an appearance of antiquity which it is extremely difficult to describe.

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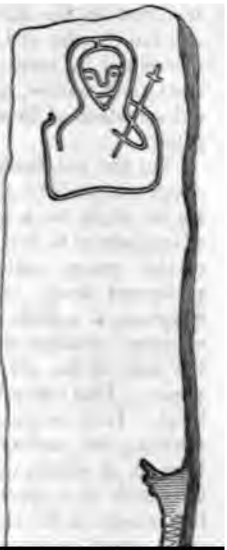
[*] bunian is female; bo, gen. boin, a cow.

About the year 1830, a wall was raised round this cemetery, and built on the line of the first terrace, and with some of its *debris*, and trees were planted inside: so that it may be hoped the existing remains will be preserved from wanton injury, and will be no further disturbed. The modern entrance faces the highroad, but at a considerable distance from it. It is on the north-west side, and probably occupies its original position.

Fig. 1.

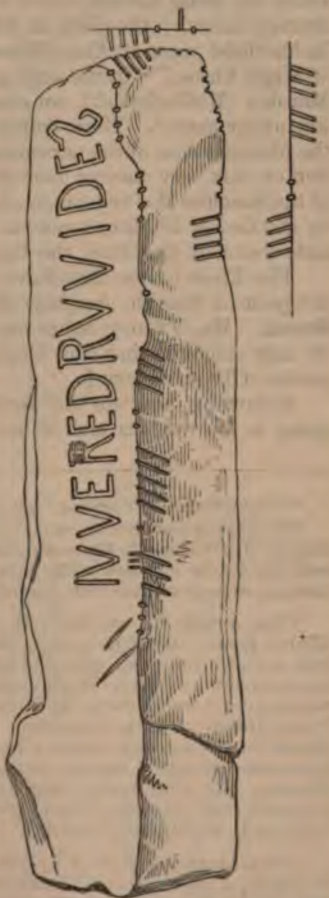


On entering, the first objects that are to be seen are two prostrate pillar stones—one on the left, the other on the right hand side.

No. 1 is a block of greenstone, partially stratified, measuring in length six feet five inches; the upper surface, at the top, ten inches wide, and at the base eight inches; the side, at the top, eleven inches deep, by fourteen inches at the base. This pillar, at its top surface, bears a faintly incised bust, which appears to represent the Redeemer, in a style of art so very archaic that any example of similar workmanship is scarcely to be found in these islands. On the same side, but near the middle, and close to the edge or oriss of this stone, three incised strokes or scores exist, as if a commencement had been made for an inscription in the Ogham character. On the side of the stone, under these scores, is a mark of the stratification, across which is cut a single score, looking, as it now stands, like a cross, being probably another attempt at an Ogham inscription.

monument of such extreme antiquity and rareness in that part of Ireland, which he regarded as fully explored. Being, however, at Killeen Cormac on an October evening, in 1860, which was showery, with intervals of bright sunshine, and then examining these monuments, the depressions of the Roman letters, being filled with water, and glistening under the setting sun, enabled him to read distinctly the words IVVE-REDRVV-IDES, and excited a most lively interest in the discovery. Rubbings were then made, and since that time very frequently, and more carefully.

Fig. 2.



This remarkable discovery was communicated to the late Eugene O'Curry, and also to the Rev. James Graves, Hon. Sec. to the Kilkenny Archæological Society, who urged the writer to make it public; which he was not then willing to do, for want of sufficient information regarding the locality and its history. After this he set about collecting the history and legends connected with this cemetery in every quarter likely to afford information. Subsequent inquiries brought to the surface many traditions of much interest, which were all but forgotten; and it is much to be regretted that similar investigations have not been made in other historic localities, as yet unexplored, by persons having the same facilities as the writer; as these traditions, if not soon collected, seem to be doomed to oblivion among the rising generation of our countrymen.

At the time these rubbings were made the writer was not acquainted with the force or phonetic value of the Ogham characters, nor does he now take it on himself to say that the Ogham is an equivalent for the Roman inscription; but in connexion with the word DRVVIDES, it has been suggested that there is a combination of Ogham characters reading the word *SAEI,* which is most probably the Irish equivalent of the DRVVIDES of the Roman or Latin inscription. At the first reading of this inscription, its great novelty gave ample room for speculation.

It struck the writer that he had perhaps alighted on the stone that may have marked the grave of Dubhtach mac ua Lugair, the chief Druid of Leinster, and St. Patrick's first convert at Tara, when opening his mission there before King Laoghaire, when he called to mind Dubhtach's connexion with St. Fiacc of Sleibte (Sletty), which is in a territory adjoining Killeen, which is itself in the very locality of Dubhtach's literary labours; the plain in which Killeen is situated being mentioned in his third poem on Enna Kinsellagh, who is there called "The Hero of Magh Fhine."* In the same poem Mugna (or Moon Columbkile), and Maisden (Mullaghmast), are named, and are in the vicinity of the locality under notice. These coincidences were supposed to give a clue to the identification of the personage commemorated in the Roman inscription on this very ancient monument; and more recently the publication of the Senchus Mor appears to add another link to the chain of evidence, by the fact of Dubhtach mac ua Lugair being there spoken of as Dubhtach doctor of literature, the Irish being Dubtach sai litri.

The River Griese that flows by this ancient cemetery is called, in the poem of Meabth, daughter of Conan, Glaissi Crichi, or the boundary stream. Mr. O'Curry refers this poem to a very remote period, so that we may conclude that this locality was one of importance at an early period of Irish history.†

Returning now to the description of the other pillar stones, and going to the western end of this mound, under the moat on the first

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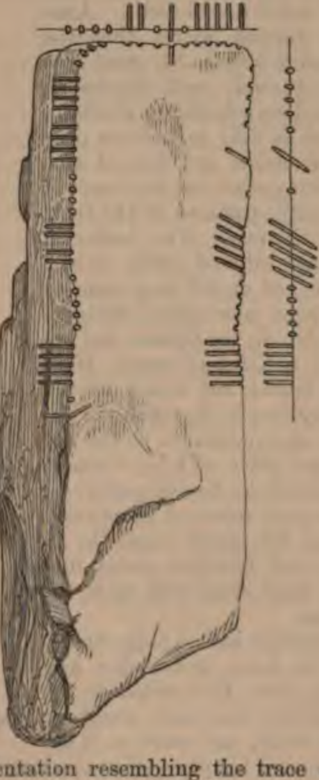
* *Vide* O'Curry's "Lectures," App. III., p. 486, note 45.

† It would appear from an extract from the "Book of Lecain," fol. 95 a, kindly supplied by Mr. William M. Hennessy, that the territory in which Killeen Cormac is situated belonged to a branch of the tribe of Messincorb, called the Ui Cormaic, or Fine Cormaic, whose possessions with those of their correlatives are thus minutely described :—

"Ite randa h. ngabla ⁊ h. Cormaic la Laignib .i. na ngebthe h. nGabla Ḟine uili, ⁊ Cuthraigi, ⁊ h. Gabla rairend, ota Ath culcinged co terrace, is another pillar stone (No. 4), standing about five feet above the surface; it is nearly square, and presents no feature of interest, except that at its eastern edge there are some scores, perhaps the remains of an Ogham inscription. On the second terrace, above this stone, is an irregular-shaped flag (No. 3). It is of coarse greenstone, very rough and hard, and much weather-worn. An Ogham inscription is carried up the two sides and top. As it has been most carefully examined, the annexed engraving is a faithful copy of the scores now existing on this curious monument.

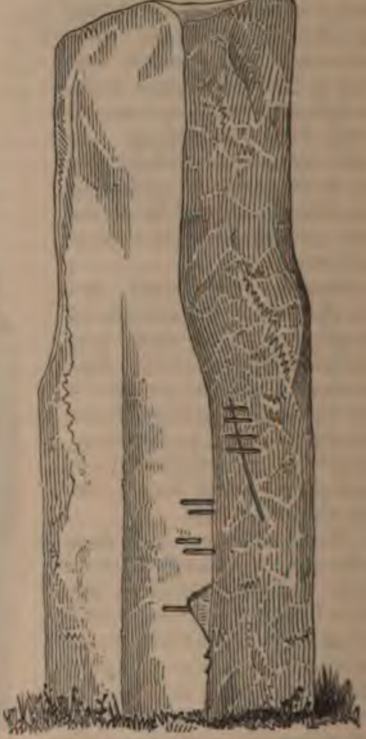
Fig. 3.



Crossing the mound, and over the site of the church, on the plateau at the north-east, stands an oblong, rough, flag-like stone, three feet nine inches over the surface, and about two feet wide, having a plain cross, incised by wide shallow lines, twenty-two inches long by fifteen across the arms.

There are some such flags in the neighbourhood—at Dunboyke and Kilranelagh—and likely belong to a very remote period, as they have not any of the characteristics of mediæval art. Near this is another pillar stone, not more than 2½ feet above the surface, on the top of which is to be seen an indentation resembling the trace of a dog's paw, as if impressed on a very soft surface. This stone was excavated from some depth, but any traces of scores or inscription were not recognised. Some years ago it was much higher above the surface, and its sinking is likely due to carelessness in making the graves, which lie about in profusion. A very curious legend is told about this stone. Tradition says that it marks the grave of Cormac King of Munster, whose name is an affix to that of the cemetery where he rests; it moreover states that he was carried to Killeen Cormac by a team of bullocks, which were allowed to follow their own instinct—a mode of settling disputes regarding sepulture not uncommon among the ancient Irish. The same tradition, though unable to state at what period or under what circumstances King Cormac died, avers that he was carried through Ballynure, from the direction of Timolin, in the county of Kildare; and when the team reached that part of Ballynure known as The Doon, the bullocks, in the eagerness of their thirst, pawed the earth, and that water issued forth. Another version states that the teamster struck his goad into the ground, and thereupon gushed up a bubbling fountain, which is still to be seen near the roadside, and is used as a watering place for the herds of the fertile pastures of The Doon of Ballynure. The bullocks, having satiated their thirst, journeyed on till they came to the place now called Bullockhill, beside the Griese, and opposite to Killeen Cormac. Here they halted, and would proceed no farther; so that Killeen was thus determined to be the last resting place of King Cormac. The bullocks, having performed their part, returned homewards across the marsh beside the river, and tradition states that they were swallowed up in the Griese.

Fig. 4.



Another legend puts a hound on the team, and makes him jump from Bullockhill to the cemetery, and there alight on this stone, and leave on it the impress of his paw—thus marking out the grave of Cormac. It may be remarked that this part of the legend looks like an interpolation from one still more ancient, concerning the hound of Cuglas, from whom Baltinglass derives its name.* He was master of the hounds to "Ederscel, the great King of Erinn," whose dogs indeed must have had paws of steel to impress their traces on full many a rock from Baltinglass to the banks of the Liffey.†

This very curious legend led to various investigations concerning this King Cormac. He could not be Cormac Mac Cullinan, King and

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* Vide *Dinnsenchus*, Book of Lecan.

† Vide Irish version of Nennius, and A. Soc. Tracts, p. 117, for a somewhat similar legend of King Arthur's hound.

Bishop of Cashel, who was slain at Beallaghmoon, in Moyailbi, in the year 908. Keating,* in his account of this engagement, states that Cormac, having a presentiment of his fate, desired to be buried in Disert Diarmid (Castledermot), in case his body could not be conveyed to Cloyne, as Disert Diarmid was the church of his friend and preceptor, the Abbot Snegdus.

There was, however, in this same fatal field of Ballaghmoon another Cormac—Cormac Mac Mothla, Prince of the Desies of Munster—who fell while in command of the left wing of the army of Munster. He may have been the Cormac of the legend in question. The tradition of the locality did not then come to the rescue. The writer, however, met some time after this a gentleman lately returned from New Orleans, who formerly lived in the neighbourhood of Killeen Cormac, whose father was a repertory of local tradition. He told his son, the informant, that the king who gave his name to Killeen was Cormac Mac Melia, King of Munster. In another interview the writer asked him if he could tell what part of Munster he came from, suggesting at the same time Desies, which his informant recognised as the name told him by his father. He had thus no small satisfaction in being able to unravel a tradition corroborating a fact of very great historical interest, if the tradition may at all be relied on.

It has been suggested that the story of the bullocks is not recorded of any except those whom public estimation has placed in the category of sanctity. While admitting the force of this suggestion, the legend in this instance appears to be very coherent, and free from vagueness.

Though it appears that Cormac Mac Cullinan had obvious reasons for selecting Disert Diarmid (Castledermot) as the place of his sepulture, that church may not have had the same attractions for Cormac Mac Mothla, and he likely selected the more ancient, and perhaps more honoured, cemetery of Killeen for the place of his burial, to which in the course of time his name may have been affixed, perhaps to distinguish Killeen from another old and curious cemetery, about two miles to the west of Killeen Cormac, and now known by the name of Kyle; or perhaps there may have been a contention between the rival churches for the honour and emolument of giving sepulture to the remains of a veteran warrior; or it may be that Cormac's friends, following an ancient precedent, may have allowed animal instinct to settle a dispute which the obstinacy or cupidity of rival interests could not have otherwise settled.

In the Life of St. Abban† there is a legend concerning his sepulture, in which bullocks are made to play a very prominent part, and the fate of these bullocks was one nearly similar to that detailed of the bullocks in the Killeen legend. It is also a curious coincidence that St. Abban is called Mac hua Cormac, being descended from an ancestor of that name, who is said to have been a king of Leinster.

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* *See* Dr. John Lynch's Latin translation of Keating, in a note to the "Annals of the Four Masters," vol. ii., p. 564, Dr. O'Donovan's Edition.

† Colgan, "Acta SS. Hib." xvi.; Martii, cap. xlvii.

In the appendix to this life, Colgan enumerates more than sixty persons of this name who were eminent for sanctity, among whom appears Cormac hua Lethain, the Abbot of Durmagh, and friend of St. Columkille, who met with a tragical fate in that territory which is now the southern part of Kildare.

It has been suggested that Killeen Cormac may be no other than the *Kil-Fine*, or Ecclesia *Fine* of the various Lives of St. Patrick, and the third church the foundation of which is referred to Palladius. A great many indirect arguments may be adduced to sustain this opinion. As the writer has made these churches a special study, and alighted on some interesting relics in the localities in which they are said to have been founded, he hopes to be able at a future period to mature his views on this subject, and to gather new facts, and evidence to sustain them, which will be found satisfactory and intelligible; and he trusts that stronger evidence and future investigations will make it possible, to connect these very remarkable and unique monuments with the names of Palladius and Dubhtach mac ua Lugair—a personage celebrated in connexion with our early ecclesiastical and national records, and in whose history and acts the recent publication of the "Senchus Mor" must awaken no inconsiderable interest.

Mr. D. H. KELLY presented a MS. Collection of Extracts, made from Memoranda Rolls of the Exchequer, and other record authorities, by the late James F. Ferguson, Esq., accompanied by the following letter:—

"GENTLEMEN,—The four volumes which I have now the honour to present to the Academy, were for sale at Kelly's, in Grafton-street, and on the point of being sold to Sir Thomas Phillips, and sent out of the country, when I fortunately became the possessor of them. On showing them to my learned and excellent friend, the Rev. W. Reeves, D. D., Secretary to this Academy, I was by him confirmed in my opinion of their value as a national record; and I was by him most generously presented with a considerable number of additional extracts, in Ferguson's own handwriting, and, amongst them, with his original autograph 'Inventory of Hugh Roe O'Neill's Effects,' which was published by him in the 'Topographer,' a copy of which is now extremely rare. Of these additional pages, which are placed in the end of vol. iii., a valuable synopsis has been made, followed by an index to their contents, both *Nominum et Locorum*, by our brother Academician, J. Huband Smith; and vol. iv. contains a very complete *Index Nominum et Locorum* to the main body of the collection, by the same skilful hand.

"I am indebted principally to my friend, Dr. Reeves, for the following account of the gifted compiler of this, I believe, valuable collection:—

"The late James F. Ferguson, of Bellfield House, Rathmines, was himself an Englishman, and in England became acquainted with

Mr. J. Lynch, when that gentleman was compiling his great work on 'Feudal Dignities;' at the instance of Mr. Lynch, Ferguson accompanied him to Ireland, where he was soon appointed, through his influence, to the office of Deputy Keeper of the Rolls, in the Chief Remembrancer's department.

"In order to give him a legal *status*, he was admitted an attorney, without service, apprenticeship or fee; but he never practised as such, nor did he derive any emolument from the profession. He held this office in the Records for several years; during the early period of which he was much employed in making searches, and furnishing materials and documents in cases of title, *Quare impedit*, &c.; and his situation became, consequently, in some degree, remunerative. But when the new Landed Estates Court and its concomitant legislation came into operation, an end was at once put to the principal sources of his emolument, and during his later years his fees of office dwindled down to something miserably small.

"He compiled Calendars to the Rolls in his custody; and a sum of one or two hundred pounds was paid over to him, on the condition of his depositing those documents as official papers belonging to the office. His latter years were passed in much pecuniary distress; and the heads of his department became desirous of removing him from his office, and from his beloved records. And here a very curious contest ensued; and, notwithstanding that his chief was extremely desirous of having him removed, he for upwards of three years continued to hold adverse possession; and, though its emoluments were gone, he stubbornly refused to vacate the office. At length they succeeded in getting him out; and penury, and ill health, and ill-remunerated literary efforts soon terminated in death, and thus deprived Ireland of one whose talents, if rightly directly and appreciated, might have been of inestimable value in illustrating the history of the land of his adoption.

"He was a most accurate and accomplished scholar in his particular line; and he furnished to the Ulster and Kilkenny Archæological volumes many valuable and interesting papers illustrative of the history of Ireland. He also published in the 'Topographer' a paper on 'The Inventory of Hugh Roe O'Neill's Effects;' which, by the generosity of the Rev. W. Reeves, D. D., is now inserted in these volumes in the handwriting of Ferguson himself. This document is most curious, interesting, and valuable, and may be taken as a sample of his proficiency in record lore.

"He wrote a beautiful hand, was thoroughly the gentleman, uniformly kind and courteous to the visitants of his office, modest and unpresuming to a fault, and always willing to communicate information from the rich store of his well-cultivated mind. He was unquestionably the best record scholar of his day in Ireland; but, when separated from his much-loved parchments, he very soon pined away, and died in the forty-ninth year of his age, on the 26th of November, 1855, and was buried in Mount Jerome Cemetery, Harold's Cross, on the 29th of the same month. He also published a small volume, entitled, 'Remarks on the Limitation of Actions Bill, intended for Ireland; together with Short Extracts from Ancient Records relating to Advowsons of Churches in Ireland.' This volume is now exceedingly rare; and I am indebted for its possession to my friend, the Rev. R. Gibbings, D. D., Professor of Ecclesiastical History in Trinity College, with whose acquiescence I have great pleasure in presenting it to the Academy, along with the Records themselves, to which it appears in some sort to be properly an appendage. And I am sure that I could not deposit such records in any more appropriate place than the Library of this Academy, where there is always such ready access to its treasures for the real student, and where information is always so freely and so courteously given.

"I have the honour to remain, Gentlemen,
"Your obedient humble Servant,
"D. H. Kelly."

The Secretary made the following presentations :—

1. On the part of P. O'Callaghan, LL. D., of Leamington, a collection of Autographs of great interest.

2. On the part of the Authors, "Memorials of the Manor of Adare," by Caroline Countess of Dunraven, and the Earl of Dunraven.

3. On the part of the Brehon Law Commissioners, Vol. I. of the Ancient Laws of Ireland.

4. On the part of the Radcliffe Trustees, the "Observations for 1862" (Vol. XXII.).

5. On the part of Richard M'Gowan, Esq., of Sandymount, Mosheim's Treatise, "De Auctoritate Concilii Dordraceni paci sacræ noxia."

Thanks were voted to the several donors.

MONDAY, JUNE 12, 1865.

The Very Rev. Charles Graves, D. D., President, in the Chair.

The President read a letter, announcing the death of Dr. C. J. Thomsen, Director of the Museum of Antiquities of Copenhagen; whereupon it was—

Resolved,—That the Royal Irish Academy desires to express the deep regret with which it has heard the announcement of the death of M. Thomsen, the founder, organizer, and director of the National Museum of Antiquities in Copenhagen; and that the President be requested to communicate this Resolution to the colleagues of Dr. Thomsen and to his family.

Mr. JOHN MORISY (with permission of the Academy) read the following paper:—

ON HINDUSTANI SYNTAX.

AT a very early stage of my Hindustani studies, which began many years ago, several imperfect, and not a few incorrect, statements came in my way while consulting the Grammars. These I was gradually enabled to rectify by a careful analysis of such passages as I found applicable from time to time. That there had been a fair open for such investigations will be easily understood from the fact, that Dr. Forbes, who published his Grammar in 1855, applied the critical rod liberally enough to his most eminent predecessors, not sparing even the native *Munshis*. But the Doctor himself is not without defects and errors; and it is to some of the chief of these, in both kinds, that I purpose to devote this short paper, with something of a better temper than is fashionable among our Orientalists. On some of the leading points I have consulted learned friends, to whom, from their long residence in India, the *Urdú* had become almost vernacular. Among them, I may mention Sir James Higginson, whose recognition of my views gave me a confidence which, perhaps, I could not have derived altogether from my own convictions. Instead of multiplying examples, I have chosen a few striking ones, and this choice has rendered very few words sufficient for my purposes.

The relative and correlative pronouns have been very indistinctly defined. Without entering into *minutiæ*, I have arranged such observations as will prove quite satisfactory, and much more intelligible than those to be met with in the Grammars.

1. When *jo* and *so* (or *wuh*) are used correlatively, *jo* appears in the secondary clause, which usually comes first in order. Each pronoun with the nearest subsequent verb constitutes a distinct clause; and this connexion with the nearest verb is scarcely ever departed from, even in verse.

i.

جو دانا لڑکا هي وه اپني کتاب اپني گهر مين بي کهي پڑهتا هي

He, who is a wise boy, without bidding reads his own book in his own house.

ii. جو دوا آنکه کي بصارت کو زياده کرتي هي سو لاؤ

The medicine which increases the sight of the eye, bring the same.

In these sentences *wuh* and *so* (which we call the antecedents) follow the relative. This may be considered its normal position, when those correlatives, or antecedents (as often they actually are), happen to be employed. In German, such is the position of wer, which must always begin the sentence or clause in which it is used; and, consequently, always precede its grammatical antecedent. The place of the antecedent, however, sometimes corresponds with its name, as it ordinarily does in English. Thus—

iii. دوسرا جو هنر جانتا تها سو اپنا پيشه کرني لگا

The second, who knew a trade, the same began to practise his work.

iv. بيٹا ميرا جو نورِ چشم اور سرورِ دل تها غائب هوا هي

Beṭá merá jo meri chashm aur surúr-i dil thá ghá,ib huá hai.

My boy, who was the light of my eye and my heart's joy, has been missing.

Those examples readily lead to a simple statement of the general connexion between the pronouns we have been noticing. In the dependent clause, *jo* may appear in proximity with the person or thing it represents; but it may not so appear without the construction being in the least affected, or any difficulty thrown in the way of the translation. In either case, however, *jo* may be considered as the relative who or which; while *so* may stand for one of the personal or demonstrative pronouns, or for *that man*, or *thing*, or *that same*, &c.

2. When the remote demonstrative, *wuh*, is substituted for *so*, the singular form is often used when the context requires the plural; but it must be observed that the license is by no means confined to this case. See example v., where *wuh* singular refers to *elche* plural.

3. In all those examples *jo* is a simple relative, and accompanied closely by its antecedent. The correlative appears in them also, except in the fourth; from which we see it may be dispensed with frequently, although the prevailing usage is otherwise. But it would be deemed faulty to omit the emphatic correlative, when the antecedent is unusually remote. Thus—

هر ملک کي پادشاهون کي ايلچي مبارک‌بادي کي خاطر جو آئي v.
تهي وه بهي سب حاضر تهي

The ambassadors of the kings of every country, who had come for the purpose of congratulation, they too were present.

Har mulk ke pádsháhon ke elche mubárak-bádí kí k̲h̲áṯir jo á,e the wuh bhí sab háẓir the.

4. *Jo* is often a compound relative; and this has been mistaken for its real character by Dr. Forbes, who says, p. 117, *d*—

"In many instances the relative *jo* corresponds with our 'who,' 'which,' or 'that;' but the student must be careful not to consider this as a rule, for it is only the exception; as follows:—*do roṭí jo beṭe kháte haiṅ*, the two loaves which my children eat."

It is quite obvious that *jo* is here the simple relative; and the remainder of the Doctor's observations lose sight of the question altogether. If need be, the employment of *wuh* in the leading clause will make the matter plainer:—*wuh ḳarẓ detá huṅ*, these I lend. The judgment of Dr. Forbes is entirely inconsistent with the frequent accompaniment of the actual antecedent, and the ordinary presence of a correlative; its reverse is the truth. But in No. vi. *jis* is clearly a compound relative, to be rendered by "by him by whom." In No. vii., *jo* may be regarded either as a simple or a compound, according as we take *so* for the antecedent; or for the emphatic correlative, if we suppose *jo* understood; and there is nothing in the language itself, or in the general principles of Grammar, to prevent either view. As in the last sentence, so in all the others, it is a pure relative—in the first two instances followed by the antecedent, but in the rest preceded by it.

vi. جِس نے مُحاورہ وهاں کا سِیکها تها خُوبِي سے جواب دِيا

vii. مُلّا نے فرمايا تها سو اب پيش آيا

5. *Jo* is occasionally used correlatively with *aisá* 'talis,' and then it corresponds with our 'as,' which has often the character of a relative. Thus—

viii.

هرگِز کِسِي سے اَيسِي بات مت کہہ جو ايک برس گُذرنے کے بعد اِعتِبار کِي جاوے

hargiz kisí se aisí bát mat kah jo ek baras guzarne ke b'ad i'tibár kí já, we.
To any one never address such an assertion as may be believed (only) after the expiration of a year.

6. *So.* Passing by the use of *ki* for *so*, and a few other particulars stated well enough in any Grammar in use, I must direct attention to the occasional service of *so* as a compound relative. I have also to observe that such a fact favours the opinion that *jo*, as such, is a license, although of frequent occurrence; but the true character of *jo* has been independently established. When in its compound character, *so* usually

appears between two verbs, to both of which it may supply subject or object. The subject is, to a European, sometimes curiously expressed, as by *log*, in No. x.

ix. I shall tell what I heard. سُنا سو بولُونگا

x. The people (or they) who went, saw him. گئي سو لوگ اُس کو ديکهي

In the last case, however, *so* may be viewed as a simple relative. Much more that Forbes has written about the relative exhibits very loose criticism: but I am restricting myself to points of absolute utility. I shall close this paper with a few words about *sá* and *mánind*, or *manand*.

7. *Sá*. The regimen of this adjective (needlessly called a particle) is not properly stated by any of the grammarians. In Dr. Forbes's Grammar, p. 108, we read—

"When added to an adjective, it seems to render the same more intensive, though frequently it is difficult to find for it an equivalent English expression; as تهوڙا سا پاني لي آو 'bring a little water;' بهت سي هتهيار وهان تهي 'there were many weapons there.' When the comparison made by سا alludes to one thing out of many, it governs the genitive case; as in the sentence

8. As to Dr. Forbes and others calling *sá* an intensive, when associated with an adjective, I never met an example which could lead me to that conclusion. In such expressions as *thoṛá sá páni lá, o; bahut se hathyár wahán the*, &c., *sá* serves as a limitation or restriction on the main idea; and, therefore, such phrases must be understood thus:—'bring *rather* a little water;' 'a good many (not very many) weapons were there,' &c. To put an end to debate upon this trifle, I lately obtained the opinion of gentlemen long resident in India, and also of Mir Ali, through a very able pupil of his, with whom I corresponded when in the country.

9. *Mánand.* Of this preposition Dr. Forbes writes, p. 98—"There is one peculiarity attending some of the feminine prepositions . . . . We have excellent authority for saying that *mánand* (and three others), when they precede the substantive, require the genitive in *ke*; and when they follow, they require *ki*." Professor Williams merely says that *mánand, bamadad*, and *t̤araf* may take *ki* when they follow the regimen—*Introduction*, p. 53; and Mr. Shakspeare, Grammar, p. 79, *note*, speaking of *mánand* in this situation, declares it is sometimes constructed with *ke*, and sometimes with *ki*. The latter is certainly the ordinary construction, but not the only one. An instance of *ke* occurs in Fable 5 of Shakspeare's Munta*kh*abat-i Hindí: *us ne us jawán ko auron ke mánand k͟hiyál kiya.*

Sir W. R. Wilde made a presentation of, and a described, a collection of Animal Remains and Flint Implements, found in the cave at Perigord by Messrs. Christy and Lartet; also the work of those gentlemen, entitled "Cavernes de Perigord;" a shilling of Henry VIII., from the Rev. F. A. Donovan; and a shilling of Queen Elizabeth, from the Rev. Thomas Langan.

The Librarian, on the part of the Master of the Rolls of England, presented thirty-four volumes of the Calendars and Historical Works now appearing under his superintendence.

The Secretary, on the part of the Hon. T. D. M'Gee, presented a copy of his "Popular History of Ireland;" also several Works relating to Canada and its Resources.

The marked thanks of the Academy were returned to the several donors.

MONDAY, JUNE 26, 1865.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

IT WAS RESOLVED,—That the sum of £50 be granted to the Council for the purchase of Antiquities, and the arrangement of the Museum.

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The Rev. Samuel Haughton, M. D., Fellow of Trinity College, Dublin, read the following paper:—

Notes on Animal Mechanics.

No. VI.—On the Muscular Anatomy of the Crocodile.

During the Easter Recess of 1864, I had an opportunity of explaining to Professor Gratiolet,[*] of Paris, the investigations I had made with respect to the mechanism of the leg of the Ostrich and the theory I had formed to explain it. This distinguished anatomist did me the honour of approving of my explanation, and urged me to procure a Crocodile, in the posterior limb of which he assured me I should find a mechanical problem exceeding in complexity that presented by the leg of the Ostrich, and as yet unsolved by anatomists.

During the month of March last I was furnished with a young Crocodile from Egypt, by Mr. Thomas Moore, Curator of the Derby Museum, Liverpool, to whom I had communicated my earnest desire to have an opportunity of dissecting such an animal; and the results of my examination fully bear out the anticipation of Professor Gratiolet, and also furnish a complete confirmation of the principles I made use of in my theory of the leg of the Ostrich.

The interlacing of tendons in the hind leg of the Crocodile is very remarkable, and more complex than in the Ostrich, although in one respect it somewhat resembles it.

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[*] The incalculable loss that science has sustained in the early part of the present year by the premature death of this gifted anatomist, is exceeded by the loss experienced by his friends, to whom his genial social qualities endeared him even more than his brilliant scientific attainments. I extract from the "Journal des Debats" of the 19th February, 1865, the following just tribute to his memory:—

"Les sciences viennent de faire une perte aussi cruelle qu'imprévue; M. Gratiolet, professeur de zoologie à la Faculté des Sciences de Paris, a succombé hier matin à une attaque d'apoplexie.

"M. Gratiolet n'avait pas cinquante ans; avant-hier, encore plein de vie et de santé, il travaillait à son laboratoire du Muséum d'histoire naturelle lorsque, à deux heures, frappé d'une congestion subite, il dut être ramené à son domicile; quelques heures plus tard, il avait perdu connaissance; hier matin à quatre heures, il rendait le dernier soupir.

"Nous ne saurions peindre l'émotion profonde qu'a causée dans le monde scientifique l'annonce de cette mort prématurée. M. Gratiolet était aimé de tous; son affabilité, la droiture de son caractère lui avaient concilié toutes les sympathies.

"Ses travaux d'anatomie comparée, ses recherches sur le système nerveux et sur le cerveau, etc., l'avaient mis au nombre des naturalistes les plus distingués de notre pays; son merveilleux talent d'élocution l'avait placé au premier rang parmi nos professeurs les plus renommés, et l'aptitude de son esprit pour les études métaphysiques avait imprimé à ses œuvres un caractère d'originalité qu'appréciaient les philosophes aussi bien que les savans.

"La mort est venue le frapper au moment où, après de longues années de lutte, il semblait sur le point de recueillir le fruit de ses laborieux efforts.

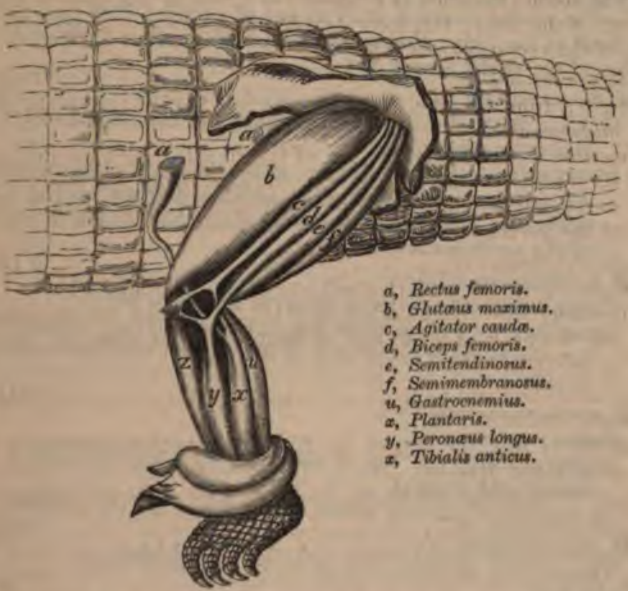
"Aimé Girard."

PART I.—DISSECTION OF LEG OF CROCODILE.

On removing the skin and dissecting away the fat, the muscles shown in Fig. 19 are exposed.

Fig. 19.

LEFT LEG OF CROCODILE (with skin removed, to show the superficial muscles).



a, *Rectus femoris.*
b, *Glutæus maximus.*
c, *Agitator caudæ.*
d, *Biceps femoris.*
e, *Semitendinosus.*
f, *Semimembranosus.*
u, *Gastrocnemius.*
x, *Plantaris.*
y, *Peronæus longus.*
z, *Tibialis anticus.*

1. *M. Glutæus maximus* (*b*), ... 0·15 oz.
   Origin; from central half of the ilio-ischiadic line.
   Insertion; into the fascia outside and above the knee joint.

This is a broad flat muscle, and straps down the tendon of the *rectus femoris* in its passage over the knee.

2. *M. rectus femoris* (*a*), ... 0·08 oz.
   Origin; from anterior spine of the ilium, close to the acetabulum.
   Insertion; as in the leg of the Ostrich, into a tendon passing over the knee outwards, and terminating in a remarkable muscle* (*x*), in the calf of the leg, associated with the *gastrocnemius* (*u*), and deriving a second origin from the *agitator caudæ* (*c*), as shown in the figure.

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* This muscle may be the *plantaris*.

3. *M. agitator caudæ* (*c*), ... 0·03 oz.
Origin; from the ischiadic line, behind the *glutæus maximus.*
Insertion; by a double tendon.

1. One tendon passes through a pulley on the outside of the knee, formed by the tendon of the *biceps* (*d*) as it passes to its fibular insertion, and is then inserted in the head of the muscle (*x*), in the calf of the leg.

2. The second insertion is by means of a tendon that goes to the top and front of the tibia; this second tendon also serves to strap down the tendon of the *rectus femoris* (*a*).

4. *M. biceps femoris* (*d*), ... 0·05 oz.
Origin; from the ilioischium, under and behind the origin of the *glutæus maximus.*
Insertion; partly into the top of the fibula, forming a pulley for the *agitator caudæ* (*c*), and an additional strap for the *rectus femoris* (*a*); and partly by means of another tendon into the head of the *peronæus longus* (*y*).

5. *M. semitendinosus* (*e*), ... 0·18 oz.
Origin; from the posterior point of the tuber ischii.
Insertion; by a remarkable looped tendon, having one end inserted into the back of lower end of femur, and the other end into the os calcis.

6. *M. semimembranosus* (*f*), ... 0·11 oz.
Origin; tuber ischii.
Insertion; into the top of the tibia, by a tendon common to this muscle and *gracilis.*

The muscles of the calf shown in the figure are the following:—

7. *M. gastrocnemius* (*u*), ... 0·14 oz.
This muscle, as usual, has an outer and inner head.
Outer head, ... 0·11 oz.
Origin; from the tendon of the great caudal extensor of the thigh, half an inch from its insertion into the outer condyle (vide *s*, Fig. 20).
Insertion; into the under side of the outer tarsal bone, and into the plantar fascia.
Inner head, ... 0·03 oz.
Origin; from the top of fibula and inner condyle of femur.
Insertion; by a tendon, which unites with that of the outer head before reaching the os calcis, under which it passes to be inserted into the outer and under side of the outer tarsal bone.

8. *M. plantaris ?* (*x*), ... 0·04 oz.
Origin; double; from *rectus femoris* and from *agitator caudæ.*
Insertion; having become partially blended with the outer *gastrocnemius,* it is inserted into the os calcis, and under surface of the plantar fascia.

9. *M. peronæus longus* (*y*), ... 0·03 oz.

Origin; from the shaft of the fibula, and from the tendon of the biceps femoris (*d*).

Insertion; into the outer tarsal bone, uniting with the tendon of the *gastrocnemius.*

10. *MM. tibialis anticus et extensor digitorum communis* (*z*), . 0·11 oz.

Insertion; into the tarsal end of the 1st, 2nd, and 3rd metatarsal bones.

The interlacing of muscles in the thigh and leg of the Crocodile, just described, is very remarkable, and more complicated than that found even in the Ostrich; and at first I was disposed to think that it threw some doubt on the explanation I had given previously of the reason for such an arrangement in the bird's leg. In the case of the Ostrich the necessity for strict simultaneity of action was made evident by the great force of the muscles employed, and the great delicacy of the bones on which they had to act. What could there be in the case of the Crocodile to correspond to such a peculiarity in the case of the Ostrich? After some careful dissection I found the ready answer to my question in the remarkable muscle which I shall now describe.

On clearing away the superficial muscles of the thigh and tail, I found the enormous mass of muscle, figured at *b*, Fig. (20), which acts as the chief and powerful extensor of the thigh.

11. *M. extensor femoris caudalis* (*b*),* . . . . 1·81 oz.

Origin; from the transverse and inferior spinous processes of the caudal vertebræ, from the 3rd to the 15th, inclusive.

Insertion; into the back of the upper part of the femur, and into a great round tendon, which receives, in particular, the anterior fibres of this enormous muscle, and, passing down the back of the femur, is inserted by a strong common aponeurosis into the outer condyle of the femur, and into the head of the fibula. This common aponeurosis also gives a partial origin to the *gastrocnemius* (*a*), Fig. 20, and to the *plantaris* (*x*), Fig. 19.

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* This remarkable muscle is noticed and accurately described by Meckel, in tome iii., pp. 152, 153, of his "System der vergleichenden Anatomie" (Halle, 1828); but it is very strange that he transposes its origin and insertion, and seems not to have had any idea of its real use. It is regarded from his point of view as a descriptive anatomist, and without the remotest reference to its final cause. He says:—"Der zweite, tiefere weit dickere Muskkel is von dem ersten [the superficial muscle of the tail] wie einer breiten Binde umgeben, entspringt mit zwei ganz getrennten, 1) einer weit kürzern, breiten Sehne oben von den hintern Fläche des Oberschenkelbeines; 2) durch eine weit längere, schlanke, unten zwischen den beiden Gelenkknorren desselben Knockens, und setzt sich an die ganze Seitenfläche der untern Dornen, so wie der Zwischendornenhaut und die untere Fläche der Wurzeln der Querfortsätze."

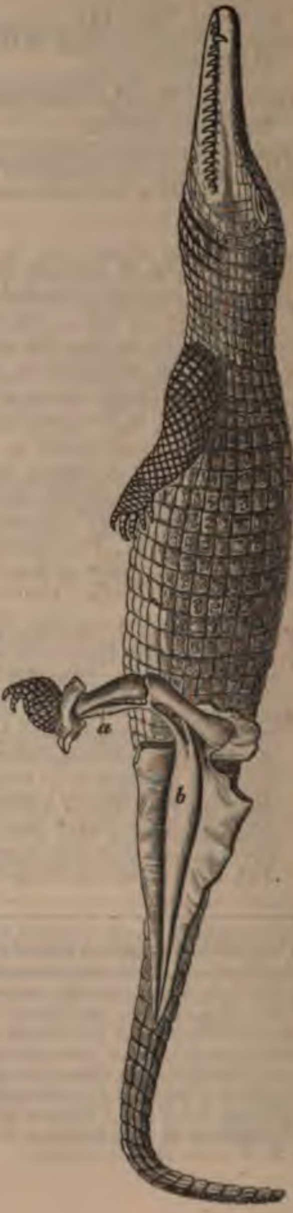
There are two muscles, accessory to this great caudal extensor in their action, which are as follows:—

12. *M. extensori femoris caudali accessorius*, . . 0·01 oz.
    Origin; from the fascia covering the great caudal extensor, and by a tendinous head from the *quadratus femoris*, which is also an accessory to the great caudal.
    Insertion; into the looped tendon of the *semimembranosus*, already described.

13. *M. quadratus femoris*, 0·05 oz.
    Origin; posterior, superior, and inner surface of the pubis, near its symphysis.
    Insertion; into the back of the femur, with the action and position of the *quadratus femoris* in mammal quadrupeds, and into the tendon of the great caudal extensor.

The effect of the interlacing of the tendons of the various muscles already described must be to produce simultaneity of action among them, such as I have already endeavoured to describe in my account of the leg of the Ostrich; and in the present instance of the Crocodile there seems to be a similar principle involved. The Crocodile, resting on mud, progresses chiefly by using his hind feet as paddles; and in this use of them the great caudal extensor of the thigh is the most

Fig. 20.



Common Crocodile of Egypt (with superficial muscles removed, to show the great deep flexor of the thigh).

a, *Gastrocnemius.* *b*, *Extensor femoris caudalis.*

powerful and important muscle employed; and it seems to me that the simultaneity of action of all parts of the leg, rendered necessary by the employment of so powerful a muscle, is fully secured by the interlacing of the tendons I have described, which renders it impossible for one set of muscles to act without the others being also exerted.

The remaining muscles of the posterior limb are as follows:—

14. *M. glutæus medius*, ... 0·06 oz.
Origin; from the central part of the ilio-ischiadic surface.
Insertion; its tendon passes over the great trochanter to be inserted into a line down the upper half of the outside of the femur, between the origins of the two portions of the *vastus externus*.

15. *M. Glutæus minimus*, ... 0·02 oz.
Origin; from the anterior point of the ilium.
Insertion, into the inner side of the knee, under the fascia of the *rectus femoris*.

16. *MM. vastus internus, externus, et cruræus*, ... 0·22 oz.
The *vastus externus* consists of two distinct muscles, as in the Ostrich.

17. *M. psoas*, ... 0·57 oz.
This large muscle takes an origin as high as the last rib, and is inserted into the lesser trochanter, and the intertrochanteric line leading to the outer side of the femur. It lies outside the *iliacus*.

18. *M. iliacus*, ... 0·11 oz.
Origin; from the anterior transverse surface of the ilium, with a slip from the spine.
Insertion; altogether into the lesser trochanter.

19. *M. sartorius*, ... 0·04 oz.
Origin; behind the origin of the *rectus*, on the inner side, at the junction of the ilium and marsupial bone.
Insertion; into the fascia of the inner side of the thigh, for two-thirds of its length.

20. *M. gracilis*, ... 0·08 oz.
Takes an origin from two heads—one at the posterior point of the pubis, and the other on the pectinæal line.
Insertion; into the head of the tibia by a tendon common to it with the *semimembranosus*.

21. *M. pectinæus*, ... 0·06 oz.
Origin; between the two heads of *gracilis*, from the central part of the surface of the pubis and from the pectinæal line.
Insertion, into the top of the linea aspera.

22. *MM. adductores*, ... 0·21 oz.

There are three adductor muscles:—

1st *Adductor*, ... 0·13 oz.

Origin; anterior pectinæal line of pubis.
Insertion; into the upper half of the linea aspera.

2nd *Adductor*, ... 0·03 oz.
Origin; from the posterior edge of the pubis, its middle third.
Insertion; into the middle of the linea aspera.

3rd *Adductor*, ... 0·05 oz.
Origin; from the posterior edge of the pubis, close to the symphysis.
Insertion; into the back of the top of the fibula, with a fascial union with the tendon of the *semitendinosus*.

23. *M. obturator externus?* . . . . 0·13 oz.
Origin; from the tuber ischii, the posterior edge of the ischium, and the obturator membrane.
Insertion; into an oblique line on the back of the femur, below the insertion of the *quadratus femoris*.

24. *M. marsupialis externus*, ... 0·07 oz.
25. *M. marsupialis internus*, ... 0·10 oz.
These two muscles take their origin, respectively, from the outer surface of the marsupial bone, and from its inner surface and the last abdominal rib; and they are inserted by a common tendon into the top of the posterior intertrochanteric line. Their action is to rotate the femur directly inwards.

26. *M. flexor proprius hallucis*, ... 0·02 oz.
Origin; from the outer condyle of femur.
Insertion; into the first, second, and third toes.

27. *M. flexor digitorum communis*, ... 0·05 oz.
Origin; from the fibula and tibia.
Insertion; into the first, second, and third toes.

28. *M. tibialis posticus*, ... 0·06 oz.
This muscle is inserted into the tarsal ends of the first, second, and third metatarsal bones.

29. *M. peronæo-calcaneus*, ... 0·01 oz.
Origin; from the lower part of the shaft of the fibula.
Insertion; into the upper surface of the calcaneum.

PART 2.—DISSECTION OF ARM OF CROCODILE.

The muscular anatomy of the anterior limb of the Crocodile presents no such remarkable peculiarities as those I have described in the leg, and therefore a rapid enumeration of its muscles will be sufficient. It is necessary to bear in mind, for the purpose of comparison with the muscles of the leg, that

The Marsupial bone represents the clavicle;
,, Pubis, ,, ,, coracoid;
,, Ilium, ,, ,, acromion;
,, Ischium, ,, ,, scapula.

1. *M. trapezius*, ... 0·10 oz.
   Origin; from the occipital and cervical scutes, as far back as the shoulder joint.
   Insertion; into the anterior edge of the acromion.
2. *M. latissimus dorsi* (*humerodorsalis*), ... 0·12 oz.
   Origin; from the four anterior dorsal scutes.
   Insertion; into the back of the humerus, having its tendon conjoined with that of the *teres major*.
3. *M. teres major*, ... 0·02 oz.
   Origin; posterior superior portion of scapula.
   Insertion; with *latissimus dorsi*.
4. *M. sterno-atlanticus*, ... 0·22 oz.
   Origin; from the sternum, in front of its articulation with the coracoid.
   Insertion; into the side of the atlas.
5. *M. pectoralis major*, ... 0·77 oz.
   Origin; from top of sternum, and its entire length, and from the abdominal ribs two-thirds of the distance to the pelvis.
   Insertion; into the outer edge of the great pectoral ridge of the humerus.
6. *M. pectoralis minor*, ... 0·04 oz.
   Origin; from the outer surface of the acromion and coracoid, lying under the tendon of the *biceps humeri*.
   Insertion; inner side of pectoral ridge.

In this muscle is also included the *supraspinatus*, which is represented by the portion of the muscle taking its origin from the scapular border of the acromion, inside the origin of the deltoid. These two pectorals draw the arm forward in swimming.

7. *M. pectoralis secundus*, ... 0·04 oz.
   Origin; from the first sternal rib.
   Insertion; into the posterior edge of the coracoid.

This muscle draws the arm backwards, by acting on the coracoid, and may represent the second pectoral of birds.

8. *M. sternomastoideus*, ... 0·17 oz.
   Origin; from top of sternum.
   Insertion; into the posterior third of inner side of lower jaw.
9. *M. Omo-hyoideus*, ... 0·06 oz.
   Origin; from the acromion, just above the glenoid cavity.
   Insertion; into the descending wing of the hyoid bone.
10. *M. deltoideus*, ... 0·15 oz.
    Origin; from a broad rim of the acromion, and from the inner surface of the acromion, winding out over the edge to form the inner portion the deltoid.
    Insertion; into the deltoid ridge of the humerus.
11. *M. infraspinatus*, ... 0·02 oz.
    Origin; from the outer surface of the scapula, which is altogether occupied by this muscle and the *teres major*.

Insertion; by a long tendon into the greater tuberosity.

12. *M. rhomboideus*, ... 0·02 oz.
Origin; from spinous processes of the last cervical and the first dorsal vertebra.
Insertion; under surface of vertebral edge of scapula.

13. *M. serratus magnus*, ... 0·26 oz.
Origin; from the transverse processes of the vertebræ, from 2nd to 8th, inclusive.
Insertion; all round the edge of acromion, and anterior and vertebral edge of the scapula.

This muscle is continuous with the next, which may be regarded as equivalent to the scapulocostal *latissimus dorsi* muscle found in the Seal.

14. *M. latissimus dorsi scapulocostalis*, ... 0·15 oz.
Origin; from the ribs of the 9th to 14th vertebræ, inclusive.
Insertion; into the posterior edge of the scapula.

15. *M. triceps*, ... 0·25 oz.
Origin, threefold:—

1. From the posterior edge of the scapula, near the glenoid;
2. By a bifurcate tendon from the coracoid and scapula, allowing the *subscapularis* to pass between the two tendons.
3. From the outer and inner surfaces of the back of the humerus.

16. *M. subscapularis*, ... 0·05 oz.
Origin; from the inner surface and anterior edge of the scapula.
Insertion; into the lesser tuberosity, and into the line leading from it down the inner side of the arm.

17. *M. biceps humeri*, ... 0·03 oz.
Origin; from the inner side of the anterior edge of the coracoid, in front of the glenoid.
Insertion; into the radius.

25. *M. pronator radii,* . . . . 0·03 oz.
    Origin; from the inner condyle of the humerus.
    Insertion; into the whole length of the radius.
26. *M. flexor carpi ulnaris,* . . . . 0·03 oz.
    Origin; from the inner condyle.
    Insertion; into the outer carpal bone, articulating with the ulna.
27. *M. palmaris* (?), ... 0·01 oz.
    Origin; from the inner condyle.
    Insertion; into the tendon of the *flexor digitorum communis* in the centre of the palm. Its force is expended on the index and middle fingers.
28. *M. flexor digitorum communis,* . . . . 0·03 oz.
    Origin; from the whole inner surface of the ulna.
    Insertion; into the ungual phalanges of the thumb, index, and middle fingers.

There are, in addition, short flexors in the palm, terminating in the metacarpal ends of the phalanges at each side, allowing the tendon of the long flexor to pass through.

The ring and little fingers seem to be flexed altogether by these palmar tendons.

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, also read the following paper:—

NOTES ON ANIMAL MECHANICS.

No. VII.—ON THE MUSCULAR ANATOMY OF THE MACACUS NEMESTRINUS.

THE first monkey which I shall describe in this Note was a very fine specimen of *Macacus nemestrinus*, which died, after a short illness, in January of the present year, of tubercular disease affecting the liver, spleen, and other organs. He had previously suffered from rheumatic arthritis of both knee joints, which had destroyed the anterior surfaces of the outer condyles of the femur, and so caused dislocation of both patellas outwards.

On examination after death, the following observations were made:—

1. *Lungs*; both filled with miliary tubercle.
2. *Heart;* exhibited two specks of tubercle, similar to those met with in the lungs.
3. *Liver;* divided into five lobes, of which four were filled with tubercular nodules, and the fifth was wholly converted into a cheesy tuberculous mass.
4. *Spleen;* contained several large nodules of softened tubercle.
5. *Glands;* of mesentery, united into one tubercular mass; of thoracic spinal region, somewhat affected; of lumbar region, healthy.

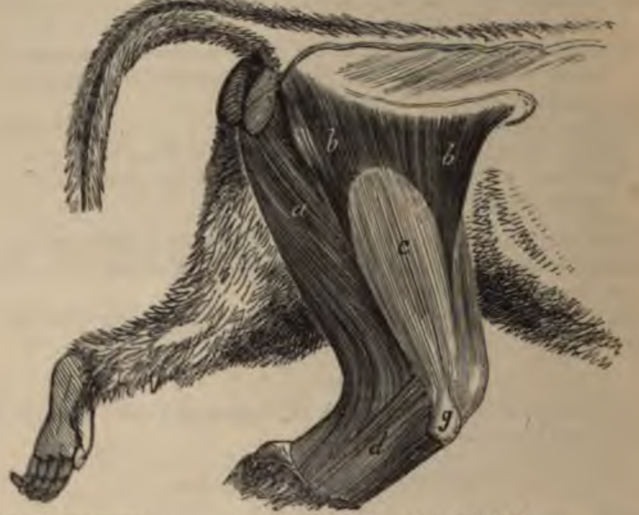
Weight of dead body, ... 26 lbs.

Muscles of Leg and Foot.

1. *MM. agitator caudæ, glutæus maximus, tensor vaginæ femoris* (Fig. 21, *b b*), ... 0·9 oz.

Fig. 21.*

HIND LEG OF MACACUS NEMESTRINUS
(with skin removed).



a, *Biceps femoris.*
b b, Combined *agitator caudæ*, *glutæus maximus*, and *tensor vaginæ femoris.*
c, Great fascia of thigh.
d, Outer portion of *gastrocnemius.*
g, Displaced patella of right knee.

These three muscles form one continuous sheet of fibres, expanded over the upper and outer portion of the thigh; they are shown at *b b*, Fig. 21.

The *agitator caudæ* forms the posterior portion of the entire muscle, and takes its origin from the first and second caudal vertebræ; the *tensor vaginæ* corresponds to the *agitator* in front of the muscle, and arises from the crest of the ilium; and the smallest, or central portion, is composed of the *glutæus maximus* proper; this muscle, however, deserves its human name so little in the Macaque, that it is only equal in weight to the *glutæus minimus*, which is 165 grs.

The whole complex muscle is inserted below and behind the great trochanter, and into the whole of the great fascia covering the thigh on the outer side.†

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* This and the following figures were drawn from nature by my son.

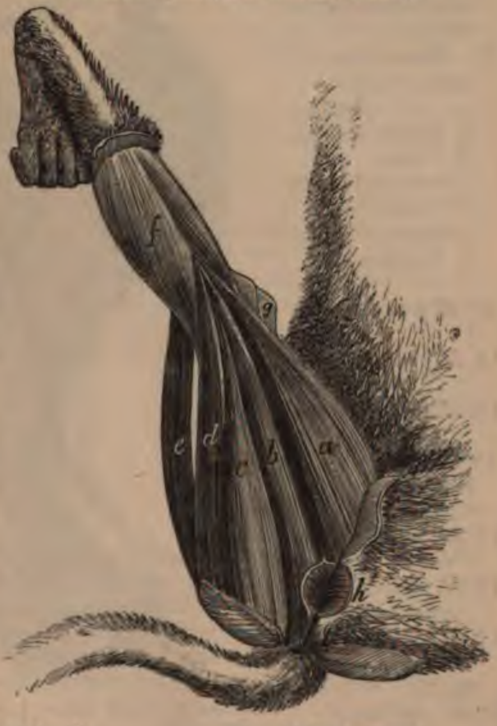
† The fibres of this curiously shaped muscle are not parallel, but converge through an angle of 16°, to a point 14½ inches from the crest of the ilium; and their resultant

2. *M. glutæus medius*, ... 1·95 oz.
3. *M. glutæus minimus*, ... 0·37 oz.
4. *M. biceps femoris* (Fig. 21, *a*; Fig. 22, *b*; Fig. 23, *e*), . 1·10 oz.
   Inserted into the back of the lower third of the femur, and by fascia down the upper third of the leg; the resultant plane of all its fibres falls below the knee joint.
5. *M. semitendinosus* (Fig. 23, *b*), ... 0·61 oz.
   Takes origin from the *tuber ischii*, and is inserted by a flat tendon into the upper point of trisection of the tibia.
6. *M. semimembranosus* (Fig. 23, *d*), 0·67 oz. Origin; the posterior line of ischium. Insertion; into the top of the tibia by a round tendon.
7. *M. gracilis* (Fig. 23, *a*), . . . 0·55 oz. Origin; from the *symphysis pubis*. Insertion; beside the *semimembranosus*, and inside the *sartorius*, into the upper fourth of the tibia.
8. *M. sartorius*, (Fig. 22, *e*), . . . 0·32 oz.
9. *M. adductor longus* (Fig. 23, *c*), 0·90 oz. Origin; from the spring of the arch of the pubis. Insertion; into the back of the inner condyle, and one inch up the femur.
10. *M. adductor magnus*, . . . 3·20 oz.

Fig. 23.

COMBINATION OF FLEXORS OF THE KNEE JOINT IN THE MACACUS NEMESTRINUS

(viewed from behind, in the lithotomy position).



a, *Gracilis*.
b, *Semitendinosus*.
c, *Adductor longus*.
d, *Semimembranosus*.
e, *Biceps femoris*.
f, *Gastrocnemius*.
g, Dislocated patella.
h, Bulb of urethra.

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divides the base line joining the crest of the ilium with the second caudal vertebra in the proportion of 21 to 36.

Origin; fleshy, from the symphysis and arch of the pubis.
Insertion; into the entire length of the back of the femur.

11. *M. adductor brevis*, ... 0·3 [illegible] oz
Origin; from the top of the symphysis pubis.
Insertion; into the second upper fourth of the back of the fe[illegible]ur.

12. *M. pectinæus*, 0·22 oz.
Origin; from the pectinæal line.
Insertion; into the upper fourth of the back of the femur.

13. *M. quadriceps extensor femoris*, 2·32 oz.
    1. *Rectus*, 0·80 oz.
    2. *Vastus externus*, 0·82 oz.
    3. *Vastus internus*, 0·40 oz.
    4. *Cruræus*, 0·30 oz.

14. *M. psoadiliacus*, 1·87 oz.

15. *M. psoas parvus*, 0·27 oz.

16. *M. iliocapsularis*, 5 grs.
Although small, this muscle was very distinct.

17. *M. quadratus femoris*, 0·46 oz.

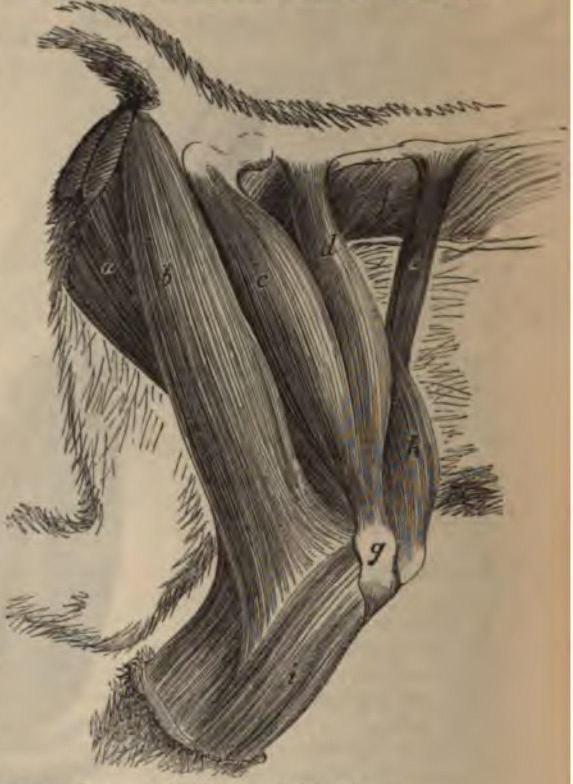
18. *M. obturator externus*, 0·53 oz.

19. *MM. obturator internus et gemelli*, 0·75 oz.

20. *M. poplitæus*, 0·06 oz.

Fig. 22.

DEEP MUSCLES OF RIGHT LEG OF MACACUS NEMESTRINUS.



a, *Semitendinosus* and *adductor longus*.
b, *Biceps femoris*.
c, *Vastus externus*.
d, *Rectus femoris*.
e, *Sartorius*.
f, *Psoadiliacus*.
g, Dislocated patella.
h, *Vastus internus*.
i, Outer portion of *gastrocnemius*.

An interesting observation may be made upon the muscles that act upon the knee joint: that they do not all act in the plane of motion of the joint itself, but at the same time their actions are so balanced, that their total resultant is, in all probability, accurately in that plane; this indeed is a result to be expected in a hinge joint like the knee, for otherwise there would be a constant wrench produced on the joint, by the unbalanced rotation outwards or inwards.

Of the muscles that flex the knee joint, the *biceps*, *semimembranosus*, and *sartorius* were found to act in the plane of the joint, while the *semitendinosus* abducted at an angle of 5° 40′, and the *gracilis* adducted at an angle of 8°.

A little consideration will serve to show, provided my postulates be admitted, that the *semitendinosus* wrenches the joint by a rotation *inwards*, represented by its weight multiplied by the sine of the angle its plane makes with the plane of motion of the knee joint; and that the *gracilis* wrenches the joint by a rotation *outwards*, represented by a similar quantity.

Hence we find

Wrenching moment *inwards* of *semitendinosus* $= 0{\cdot}61 \times \sin 5° 40' = 0{\cdot}06$ oz.
" *outwards* of *gracilis* $= 0{\cdot}55 \times \sin 8° = 0{\cdot}07$ oz.

These two wrenching moments nearly balance each other, so as to leave little or no strain on the joint; and it is probable that the slight difference between them is compensated by the action of the *poplitæus*, which aids the *semitendinosus* to some extent.

The flexors of the leg are well shown in Fig. 23, which represents them all in their natural positions, with the exception of the *biceps*, which has been drawn out of its place, in order to show better the position of the remaining muscles.

21. *M. gastrocnemius*,	0·89 oz.
22. *M. solæus*,	0·63 oz.
23. *M. plantaris*,	0·18 oz.
24. *M. flexor digitorum longus*,	0·36 oz.
25. *M. tibialis posticus*,	0·30 oz.
26. *M. flexor hallucis longus*,	0·66 oz.
27. *M. accessorius*,	0·05 oz.

The tendon of the *flexor hallucis* divides, in the centre of the sole, into tendons distributed to the 3rd and 4th toes, and another tendon which constitutes half the tendon of the hallux.

The tendon of the *flexor digitorum* divides at the same point into tendons distributed to the 2nd and 5th toes, and another tendon which constitutes the remaining half of the tendon of the hallux.

The *M. accessorius* tendon meets all the foregoing at the point of subdivision; but its largest branch is continued directly on, into the tendon of the *flexor hallucis*.

The distribution of the flexor tendons to the toes varies in different genera of Monkeys.

In the *Cebus*, their distribution is like that of the *Macacus nemestrinus*, viz., *flexor hallucis* to 3rd, 4th, and half the hallux;

and *flexor digitorum* to the 2nd, 5th, and half the hallux; and they all anastomose together in the sole of the foot, where they are joined by the *accessorius.*

In the *Cercopithecus fuliginosus* (Cuvier), or Sooty Mangaby, with white eyelid, the *flexor digitorum* supplies the tendons of the 2nd and 5th toes, and one-third of the tendon of the hallux; the *flexor hallucis* supplies the tendons of the 3rd and 4th toes, and two-thirds of the tendon of the hallux; and there is no *accessorius* muscle.

In the *Hapale*, the *flexor hallucis* supplies the 3rd and 4th toes only, so that its human name becomes inappropriate; and the *flexor digitorum* supplies the 2nd and 5th toes, with a small slip to the hallux.

In the *Lagothrix* the *accessorius* muscle is wanting, and the *flexor hallucis* is distributed to the 2nd, 3rd, and 4th toes, and partly to the hallux, while the *flexor digitorum* supplies the 4th and 5th toes, and partly the hallux.

In the *Chimpanzee*, the *flexor hallucis* supplies the whole tendon of the hallux (to which one-third of its force is sent), one-third of the tendon of the 2nd toe, two-thirds of that of the 3rd toe, and the whole of the 4th toe; while the *flexor digitorum* supplies two-thirds of the tendon of the 2nd toe, one-third of that of the 3rd toe, and the whole of the 5th. There is no *accessorius.*

In *Man*, the *flexor hallucis* supplies the whole tendon of the hallux, and half that of the 2nd toe (two-thirds of its force going to the hallux, and one-third to the 2nd toe); and the *flexor digitorum* supplies the remaining half of the tendon of the 2nd toe, and the whole tendons of the 3rd, 4th, and 5th toes; and the *accessorius* combines the two tendons together in the sole of the foot, pulling on both.

The different mechanical uses of the foot, indicated by these various

35. *M. flexor digitorum brevis* (*perforatus*),	0·08 oz.

This muscle is divided into two parts:—

1. *Flexor indicis perforatus*, having the human origin.
2. *Flexor digitorum*, having an origin from the *flexor digitorum longus* tendon, to which it is an accessory muscle.

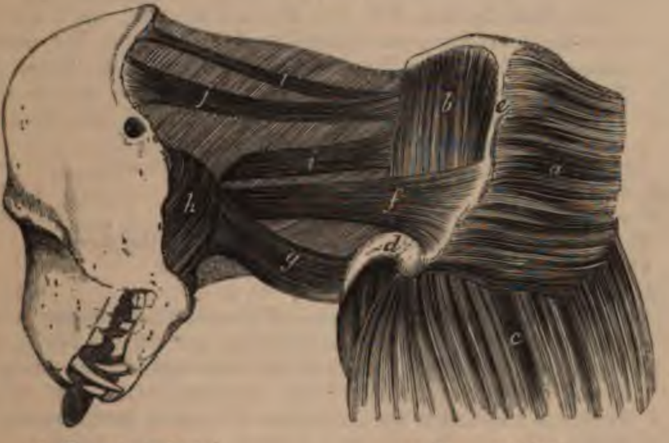
36. *M. abductor minimi digiti*,	0·04 oz.
37. *M. flexor hallucis brevis*,	0·07 oz.
38. *M. adductor hallucis*,	0·22 oz.

Muscles of Arm and Hand.

1. *M. trapezius*,	1·50 oz.
2. *M. omo-atlanticus* (Fig. 24, *f*),	0·31 oz.

Fig. 24.

MACACUS NEMESTRINUS.



a, *Trapezius*, reflected.
b, *Supraspinatus*.
c, *Deltoideus*.
d, Clavicle.
e, Spine of scapula.
f, *Omo-atlanticus*.
g, *Sternomastoideus*.
h, *Massetericus*.
i, Accessory atlantic slip of *serratus magnus*.
jj, Accessory occipital slips of *rhomboideus*.

Origin; from the transverse process of the atlas.

Insertion; into the anterior third of spine of scapula.

The insertion of the omo-atlantic muscle in the *Macacus nemestrinus* forms an exception to its usual insertion in the smaller Macaques, in which it is attached to the third of both the clavicle and spine of the scapula nearest the shoulder joint. Its insertion in the *M. nemestrinus* is like that of the Cercopitheci. In *Cynocephalus porcarius* and *C. maimon* it is inserted into the outer third of the spine of the scapula only. This muscle is wanting in the Cebus.

3. *M. rhomboideus* (*vide* Fig. 24, *jj*), ... 0·70 oz.

Origin; from the spinous processes of the upper half of the dorsal vertebræ, all the cervical, with *two* accessory slips from the occipital ridge, shown at *jj*, Fig. 24.

Insertion; into the vertebral edge of the scapula.

One or more of these accessory slips of the rhomboid muscle are present in most of the Macaques and Cercopitheci, and Cynocephali; they are to be regarded as portions of the rhomboid, with origin extended to the head, and are connected with motions of the head and shruggings of the shoulder, essentially ape-like, and not human. The accessory slip of the Rhomboid muscle is wanting in the Cebus.

4. *M. sternomastoideus* (Fig. 24, *g*), ... 0·61 oz.

5. *M. pectoralis major*, ... 1·62 oz.

6. *M. pectoralis minor*, ... 0·83 oz.

This muscle is divisible into two portions, of which the first takes origin from the 2nd, 3rd, 4th, 5th, and 6th ribs, and is inserted into the top of the great tuberosity of the humerus, the coracoid process, and capsular ligament; this portion of the lesser pectoral weighs 0·57 oz.; the second portion of the muscle arises from the 6th, 7th, and 8th ribs, and is inserted into the upper and anterior margin of the bicipital groove.

The first portion may be regarded as a *levator humeri*.

7. *M. deltoideus*, ... 1·37 oz.

8. *M. subclavius* (second pectoral of birds?) . . . . 0·13 oz.

Origin; from the junction of the first rib with the sternum.

Insertion; into the inferior edge of the clavicle.

9. *M. latissimus dorsi*, ... 2·57 oz.

This muscle is inserted, by means of a broad tendon common to it with the *teres major*, into the humerus beneath the *biceps*, and also by a tendinous band passing over and binding down the *biceps*, into the outer side of the humerus. One head of the *triceps* is attached to the *latissimus dorsi*, as it passes across the axilla.

10. *M. serratus magnus* (*vide* Fig. 24, *i*), ... 1·66 oz.

In this muscle I have included the *levator anguli scapulæ*, which cannot be separated from it as a distinct muscle, and also the distinct slip figured at *i* (Fig. 24), which takes its origin from the posterior tubercle of the transverse process of the atlas.

11. *M. supraspinatus* (Fig. 24, *b*), ... 0·85 oz.

12. *M. infraspinatus*, ... 1·07 oz.

13. *M. triceps*, ... 3·33 oz.

This muscle has four heads—

1. From the *latissimus dorsi*.
2. From the anterior half of the lower edge of the scapula.

3, 4. Double origin, fleshy, from the back of the humerus, as in Man.

14. *M. teres major*, ... 0·80 oz.
Origin; from the posterior inferior angle of the scapula.
Insertion; with the *latissimus dorsi*, by means of a broad tendon, of which the *teres* forms two-thirds, and the *latissimus* one-third.

15. *M. teres minor*, ... 0·15 oz.
16. *M. subscapularis*, ... 1·45 oz.
17. *M. biceps humeri*, ... 1·57 oz.
18. *M. coracobrachialis*, ... 0·12 oz.
This muscle is intimately blended with the coracoid head of the *biceps*.

19. *M. brachialis anticus*, ... 0·47 oz.
20. *M. pronator radii teres*, ... 0·32 oz.
21. *M. flexor carpi radialis*, ... 0·37 oz.
22. *M. palmaris longus*, ... 0·18 oz.
23. *M. flexor sublimis digitorum*, ... 0·77 oz.
24. *M. flexor carpi ulnaris*, ... 0·73 oz.
25. *M. supinator radii longus*, ... 0·77 oz.
26. *M. extensor carpi radialis longior*, ... 0·33 oz.
27. *M. extensor carpi radialis brevior*, ... 0·32 oz.
28. *M. extensor digitorum communis*, ... 0·34 oz.
29. *M. auricularis*, ... 0·08 oz.
This little muscle sends a tendon to the 4th as well as to the 5th finger.

30. *M. extensor carpi ulnaris*, ... 0·28 oz.
31. *M. flexor digitorum profundis*, }
M. flexor pollicis longus, } . . . . 1·95 oz.

There is no distinct *flexor pollicis longus;* but a tendon branches off to the thumb, from the central portion of the tendon of the *flexor digitorum profundus*, that supplies the 3rd and 4th fingers. I found by trial that the weights of equal lengths of the thumb tendon and common tendon to the other four fingers were as 116 to 243; showing that one-third of the whole force of the muscle is expended on the thumb, and the remaining two-thirds on the other fingers—for it is easy to see that the forces acting along the subdivided tendons must be exactly proportional to their strengths as measured by the weights of equal lengths.

The peculiarities of the human *flexor pollicis longus* have always been insisted upon by anatomists as essentially characteristic of Man, as distinguished from the Quadrumans; but exceptions of the most startling kind are occasionally met with. While I was engaged in the dissection of the *Macacus nemestrinus*, I called the attention of Mr. Finney, Medical Scholar of Trinity College, to the arrangement of the tendons of the deep flexor, who then mentioned to me the case of a male subject dissected by him in November, 1864. On referring to his note book, I was able to extract the following observation:—

> "Abnormal *flexor pollicis longus*.—The fleshy origin of this muscle from the bone of the forearm was entirely wanting, and the tendon of the *flexor pollicis longus* was attached opposite to the base of the 3rd metacarpal bone, to the tendons of the *flexor digitorum profundus*, on their superficial surface."

This remarkable example shows that Man may sometimes possess the arrangement of tendons of thumb and fingers characteristic of the Macaque; but whether such a case should be regarded as a Macaque passing upwards into a Man, or a Man passing downwards into a Macaque, or as a congenital freak of nature, I cannot undertake to say.

In the *Cercopithecus fuliginosus* (Cuvier), the tendon of the *flexor pollicis longus* springs, as in the Macaque, from the central portion of the tendon of the *flexor profundus* that supplies the middle and ring fingers.

In the Cebus and Lagothrix, a more degraded type of thumb is found; for the *flexor pollicis longus* is represented by a tendon to the thumb, not proceeding from the central portion of the tendon of the *flexor profundus*, but by a tendon which is merely one of the five tendons into which the *flexor profundus* is divided in the lower animals.

It is remarkable, however, that among the Quadrumans the most degraded type of thumb is to be found in the so-called Anthropoid Chimpanzee, for an opportunity of dissecting which, as well as the Negro Monkey, I am indebted to the kindness of Mr. Thomas J. Moore, Curator of the Derby Museum, of Liverpool. In the Chimpanzee, the tendon of the *flexor pollicis longus* is formed by the union of two small thread-like tendons; of which one, of silky texture, is derived from the muscle of the *flexor sublimis* (*perforatus*), of the index finger; and the other, equally slender, but wanting the silky lustre, proceeds from the tendon of the *flexor sublimis* of the little finger.*

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* The following remarks on this curious subject, by Professor Gratiolet, will be read with interest by anatomists:—

"The anatomical examination of this Chimpanzee (*Troglodytes Aubryi*) reveals profound and really typical differences between man and the most elevated apes. In the latter the thumb is bent by an oblique division of the common tendon of the muscle which bends the other fingers; it is, therefore, influenced by the common movements of flexion, and therefore is not free. This type is realized in the Gorilla and Chimpanzee; but the small tendon which moves the thumb is in these reduced to a tendinous-thread, which exerts no action, for its origin is lost in the synovial folds of the tendons which bend the other fingers, and it abuts on no muscle; the thumb, therefore, in these apes is wonderfully enfeebled. In none of them is there a trace of the large independent muscle which gives movement to the human thumb. Far from becoming more strongly deve-

32. *M. pronator quadratus,*	0·10 oz.
33. *M. supinator radii brevis,*	0·22 oz.
34. *M. extensor ossis metacarpi pollicis,*	0·25 oz.
35. *M. extensor primi internodii pollicis,* *M. extensor secundi internodii pollicis,* } united,	0·05 oz.
36. *M. indicator,*	0·05 oz.
This muscle sends a tendon to the middle finger, as well as to the index.	
37. *M. abductor pollicis,*	0·05 oz.
38. *M. opponens pollicis,*	0·03 oz.
39. *M. flexor pollicis brevis,*	0·11 oz.
40. *M. adductor pollicis,*	0·03 oz.

The Rev. Samuel Haughton, M. D., Fellow of Trinity College, Dublin, read the following paper:—

Notes on Animal Mechanics.

No. VIII.—Further Comparison of the Hip Joint and Knee Joint Muscles in the Cercopithecus, Cynocephalus, and Macacus.

Since publishing in Notes I. and II. my earlier observations on the muscular mechanism of the hip joint in Man and some of the lesser Monkeys, I have made further observations on this subject, a summary of which seems to me worthy of being laid before the Academy.

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loped, the member so characteristic of the human hand seems in the most elevated apes (the Orangs) to incline to a complete annihilation. These apes, therefore, have nothing in the organization of their hand which indicates a passage into the human form; and I insist in my memoir on the profound differences revealed by the study of the movements in hands formed to accomplish objects of a totally distinct order. A close examination of the muscles of the arm and shoulder in the pretended anthropomorphous apes confirms these results. Besides, it is especially in the ape in appearance the most like man—the Indian Orang—that the hand and foot present the most striking degradations. This paradox—this default in the parallelism in man and the large apes in the developement of correlative organs, such as the brain and the hand—shows absolutely that other harmonies and other destinies are here in question.

"The facts upon which I insist permit me to affirm, with a conviction founded on a personal and attentive study of all at present known, that anatomy gives no grounds for the idea, so violently defended now-a-days, of a close relationship between man and ape. One may invoke in vain some ancient skulls, evident monstrosities, found by chance, such as that of Neanderthal—and here and there similar forms may now be found; they belong to idiots. One of these was discovered a few years ago by Dr. Binder, who, at the request of M. Macé, presented it to me. It is now in the collection belonging to the Museum. It will henceforth be counted among the elements of the great discussion on the nature of man which now agitates philosophers and troubles consciences; out of which discussion, some day, the divine majesty of man shall arise consecrated by combat, and ever henceforth be inviolable and triumphant."

1. *Cercopithecus mona ?* (male).

From the dissection of a specimen of a male *Cercopithecus mona* I obtained the following results:—

Muscle.	Actual Weight. Grs.	Percentage.	
1. Psoadiliacus,	385	9·5	
2. Adductores,	836	20·7	
3. Glutæus maximus,	209	5·1	
4. Glutæus medius,	407	10·1	
5. Glutæus minimus,	44	1·1	
			46·5
1. Biceps femoris,	561	13·9	
2. Semimembranosus, 3. Semitendinosus,	330	8·1	
4. Gracilis, 5. Sartorius,	198	4·9	
6. Quadriceps extensor femoris,	1080	26·6	
			53·5
Totals,	4050 grs.	100·0	100·0

	Grs.
Weight of Monkey,	51,860
„ heart,	286
„ liver,	1650
„ brain,	946

	Percentage.
Proper muscles of hip joint,	46·5
Flexors of knee,	26·9
Extensors of knee,	26·6
	100·0

On projecting the planes of motion of the hip joint muscles on the plane of the rim of the acetabulum, I obtained the following results:—measuring the azimuths of the moments from the plane of motion of the knee joint, which is the natural zero plane for the hip joint—

Muscle.	Azimuth.	Moment.
1. Psoadiliacus,	20°	9·5
2. Adductores,	139	20·7
3. Glutæus maximus,	326	5·1
4. „ medius,	341	10·1
5. „ minimus,	351	1·1

If we refer these moments to the plane of motion of the knee joint, which is the plane of Flexion and Extension of the thigh upon the body, and to the plane of Adduction and Abduction, perpendicular to the former plane, we can readily construct the following Table of Component Moments:—

Component Moments of Hip Joint Muscles of Cercopithecus mona.

Muscle.	Flexion.	Extension.	Adduction.	Abduction.
1. Psoadiliacus, ...	8·93	..	3·25	..
2. Adductores, ...	..	15·62	13·58	..
3. Glutæus maximus,....	4·23	..	..	2·85
4. „ medius, ...	9·55	..	..	3·29
5. „ minimus,....	1·08	..	..	0·17
Totals, ..	23·79	15·62	16·83	6·31

Subtracting the moments acting in opposite directions, we find—

	Percentage.
Total flexion, ...	8·17
Total adduction, ...	10·52

2. *Cercopithecus callitrichus?* (male).

From a fine specimen of this Monkey I obtained the following results:—

Muscle.	Actual Weight. Grs.	Percentage.	
1. Psoadiliacus, ...	360	8·0	
2. Pectinæus, ...	88	1·9	
3. Obturator externus, ...	77	1·7	
4. Adductores, ...	710	15·4	
5. Quadratus femoris, ...	66	1·4	
6. Obturator internus, ...	100	2·2	
7. Glutæus maximus, ...	192	4·2	
8. „ medius, ...	490	10·6	
9. „ minimus, ...	60	1·3	
			46·7
1. Biceps femoris, ...	649	14·1	
2. Semimembranosus, ...	297	6·4	
3. Semitendinosus, ...	176	3·8	
4. Gracilis, ...	198	4·3	
5. Sartorius, ...	33	0·7	
6. Quadriceps extensor femoris, ..	1111	24·0	
			53·3
Totals, ...	4607 grs.		100·0

	Percentage.
1. Proper muscles of hip joint, ...	46·7
2. Flexors of knee, ...	29·3
3. Extensors of knee, ...	24·0
	100·0

Referring the moments of the hip joint muscles to the plane of the brim of the acetabulum, I found—

Muscle.	Azimuth. Degs.	Moment. Percentage.
1. Psoadiliacus,	20	8·0
2. Pectinæus,	94	1·9
3. Adductores,	137	15·4
4. Obturator externus,	149	1·7
5. Quadratus femoris,	180	1·4
6. Obturatur internus,	230	2·2
7. Glutæus maximus,	326	4·2
8. " medius,	341	10·6
9. " minimus,	351	1·3
		46·7

If these moments be resolved, as before, along the directions of Flexion and Extension of the knee joint, and of abduction and adduction perpendicular to it, we find—

Muscle.	Flexion.	Extension.	Adduction.	Abduction.
1. Psoadiliacus,	7·52	..	2·73	—
2. Pectinæus,	..	0·13	1·89	—
3. Adductores,	..	11·24	10·50	—
4. Obturator externus,	..	1·46	0·87	—
5. Quadratus femoris,	..	1·40	..	—
6. Obturator internus,	..	1·41	..	1·68
7. Glutæus maximus,	3·48	..	..	2·35
8. " medius,	10·02	..	..	3·45
9. " minimus,	1·28	..	..	0·20
Totals,	22·30	15·64	15·99	7·68

Subtracting opposite moments, we find—

	Percentage.
1. Total flexion,	6·66
2. Total adduction,	8·31

3. *Cynocephalus porcarius* (Chacma).

From a specimen of this Cynocephalus, I obtained the following results and measurements:—

Muscle.	Actual Weight. Ozs. Av.	Percentage.	
1. Psoadiliacus,	0·35	3·1	
2. Pectinæus et Adductor brevis,	0·17	1·5	
3. Obturator externus,	0·27	2·4	
4. Adductor magnus et longus,	1·40	12·6	
5. Quadratus femoris,	0·14	1·3	
6. Obturator internus,	0·31	2·8	
7. Glutæus maximus,	0·57	5·1	
8. „ medius,	1·27	12·3	
9. „ minimus,	0·22	2·0	
			43·1
1. Biceps femoris,	1·40	12·6	
2. Semimembranosus,	0·95	8·5	
3. Semitendinosus,	0·48	4·2	
4. Gracilis,	0·51	4·5	
5. Sartorius,	0·28	2·6	
6. Rectus femoris,	0·63	5·6	
7. Vastus externus,	1·40	12·6	
8. „ internus,	0·45	4·0	
9. Cruræus,	0·25	2·3	
			56·9
Totals,	11·05 oz.		100·0

Proper muscles of hip joint,	43·1
Flexors of knee,	32·4
Extensors of knee,	24·5
	100·0

Referring the moments, as before, to the plane of the rim of the acetabulum, I found—

Muscle.	Azimuth. Degs.	Moment. Percentage.
1. Psoadiliacus,	28	3·1
2. Pectinæus et adductor brevis,	74	1·5
3. Adductor magnus et longus,	137	12·6
4. Obturator externus,	148	2·4
5. Quadratus femoris,	180	1·3
6. Obturator internus et Gemelli,	226	2·8
7. Glutæus maximus, &c.,	328	5·1
8. „ medius et pyr.,	347	12·3
9 „ minimus,	355	2·0
		43·1

Resolving these moments, as before, we obtain—

Muscle.	Flexion.	Extension.	Adduction.	Abduction.
1. Psoadiliacus, ...	2·74	..	1·45	..
2. Pectinæus et Ad. brevis,	0·41	..	1·44	..
3. Obturator externus, ..	..	2·03	1·27	..
4. Add. mag. et long., ..	..	9·21	8·59	..
5. Quadratus femoris, ..	..	1 30	..	..
6. Obt. int. et Gemell., ..	..	1·94	..	2·01
7. Glut. max., &c., ...	4·33	..	..	2·70
8. ,, med. et pyriform.,	12·23	..	..	2·76
9. ,, minimus,......	1·99	..	..	0·17
Totals, ...	21·70	14·48	12·75	7·64

Subtracting opposite moments, we find—

	Percentage.
Total flexion, ...	7·22
Total adduction, ...	5·11

4. *Macacus nemestrinus.*

The following Tables are deduced from Note VII., on the Muscular Anatomy of the *Macacus nemestrinus* :—

Muscle.	Actual Weight. Ozs. Av.	Percentage.	
1. Psoadiliacus, ...	1·87	10·9	
2. Pectinæus, ...	0·22	1·3	
3. Adductor brevis, ...	0·37	2·1	
4. ,, magnus, ..	3·20	18·8	
5. Obturator externus, ...	0·53	3·1	
6. Adductor longus, ...	0·90	5·3	
7. Quadratus femoris, ...	0·46	2·7	
8. Obturator internus, &c., ...	0·75	4·4	
9. Glutæus maximus, &c., ...	0·90	5·2	
10. ,, medius, &c., ...	1·95	11·4	
11. ,, minimus, &c., ...	0·37	2·1	
			67·3
1. Biceps femoris, ...	1·10	6·8	
2. Semimembranosus, ...	0·67	3·9	
3. Semitendinosus, ...	0·61	3·5	
4. Gracilis, ...	0·55	3·2	
5. Sartorius, ...	0·32	1·8	
6. Rectus femoris, ...	0·80	4·7	
7. Vastus externus, ...	0·82	4·8	
8. ,, internus, ...	0·40	2·3	
9. Cruræus, ...	0·30	1·7	
			32·7
Totals, ...	17·09		100·0

	Percentage.
Proper muscles of hip joint, ...	67·3
Flexors of knee, ...	19·2
Extensors of knee, ...	13·5

Referring the moments of the hip joint muscles to the rim of the acetabulum, I found—

Muscle.	Azimuth. Degs.	Moment. Percentage.
1. Psoadiliacus, ...	26	10·9
2. Pectinæus, ...	55	1·3
3. Adductor brevis, ...	86	2·1
4. „ magnus, ...	132	18·8
5. Obturator externus, ...	132	3·1
6. Adductor longus, ...	157	5·3
7. Quadratus femoris, ...	180	2·7
8. Obturator internus et Gemelli,	223	4·4
9. Glutæus maximus, &c., . .	335	5·2
10. „ medius, &c., . . .	348	11·4
11. „ minimus, . . .	356	2·1

Resolving these moments, as before, we obtain—

Muscle.	Flexion.	Extension.	Adduction.	Abduction.
1. Psoadiliacus, ...	9·77	. .	4·78	. .
2. Pectinæus, ...	0·74	. .	1·06	. .
3. Adductor brevis, ...	0·14	. .	2·09	. .
4. „ magnus, . . .	. .	12·58	13·97	. .
5. Obturator externus, .	. .	2·07	2·30	. .
6. Adductor longus, . .	. .	4·88	2·07	. .
7. Quadratus femoris, . .	. .	2·70	. .	. .
8. Obturator internus, . .	. .	3·22	. .	3·00
9. Glutæus maximus, .	4·71	. .	. .	2·76
10. „ medius, ...	11·15	. .	. .	2·37
11. „ minimus, ...	2 09	. .	. .	0·14
Totals, ...	28·60	25·45	26·27	8·27

Subtracting the opposite moments, we find—

	Percentage.
Total flexion, ...	3·15
Total adduction, ...	18·00

If we collect together the preceding results into one Table, having first reduced them to percentages of the proper muscles of the hip joint, we shall obtain the following results, which represent the total flexion and adduction, expressed as percentages, compared with each other.

	Total Flexion.	Total Adduction.
1. Cercopithecus mona,	17·57	22·62
2. ,, callitrichus,	14·26	17·79
3. Cynocephalus porcarius,	16·75	11·85
4. Macacus nemestrinus,	4·68	26·74

The relative proportions of the Glutæi muscles, in the smaller monkeys, I have found to be as follows:—

	Gl. max.	Gl. med.	Gl. min.
1. Cercopithecus mona,	31·6	61·6	6·8
2. ,, callitrichus,	25·9	66·0	8·1
3. Cynocephalus porcarius,	27·7	61·6	10·7
4. Macacus nemestrinus,	28·0	60·6	11·4
5. Lagothrix Humboldtii,	37·9	54·5	7·6

The PRESIDENT read the following communication from the Rev. EDWARD HINCKS:—

ON THE VARIOUS YEARS AND MONTHS IN USE AMONG THE EGYPTIANS.

THE author began by referring to his former paper on a similar subject, read before the Academy in 1838, and published in its "Transactions." The conclusions arrived at in that paper were, he observed, vitiated by a discovery made by Brugsch, that Champollion had mistaken the seasons of the Egyptian year; that the third season, which he had believed to be that of the inundation, was in reality the genial season; and the first season, which followed this, was the true season of the inundation. Fully recognising the importance of this discovery, and of others made by Brugsch, Dr. Hincks could not acquiesce in what he had put forward as his latest discoveries—namely, that the wandering year of 365 days was unknown to the Egyptians; and that the only years used by them through the whole period of their history were the sacred year, commencing with the rising of Sothis on the 20th or 21st July of our present calendar; and the civil year, commencing about forty days after. Each of these had 365 days in three successive years, and 366 in the fourth. The principal object of the present paper was to controvert these new opinions. He admitted the existence of such a sacred year as that of M. Brugsch; which, however, was not a discovery of his, but what all Egyptologers have long since recognised; but he maintained that the Egyptians had a civil year of 365 days since 2783 B.C., and that they never had a civil year with intercalations, beginning near the end of August, until after the taking of Alexandria by Cæsar Octavianus. In support of the first proposition, he appealed first to the testimonies of various astronomical writers, and of Censorinus. In the course of his argument he noticed the mistake which Brugsch had made respecting an astrological Papyrus at Paris, which he assigned to the *tenth* year of Antoninus, the real date being the *first* year of Antoninus; and the positions of the Sun, Moon, and Saturn noted therein being certainly those which they occupied on the 4th December, A. D. 137. This correction cuts at the root one of M. Brugsch's principal arguments. Dr. Hincks then digresses to the consular fasti, which, as generally received, are inconsistent with this date existing in a contemporary record. He points out a consulship in the reign of Vespasian, which has been, he thinks, improperly inserted, and one in the reign of Alexander Severus which has been improperly omitted. He then considers the testimony of S. Clemens Alexandrinus, whose dates respecting the birth and death of our Lord can have no significance unless the years which he uses were years of 365 days without intercalation. Admitting this, his dates of the birth and crucifixion of our Lord, of the taking of Jerusalem, and of the death of Commodus, are found to be dates of the wandering year, corresponding respectively to the 5th January, 3 B. C.; 7th April, A. D. 30; 2d September, A. D. 70; and 31st December, A. D. 191. The second of these dates, it is observed, is that of Bishop Ellicott. The double date on the Rosetta Stone is then considered; and it is shown, by a reference to Archbishop Ussher's work on the Macedonian Solar Year, that it is in perfect harmony with the Egyptian date, being that of the wandering year, and quite inconsistent with its belonging to a fixed year, such as M. Brugsch has imagined. Dr. Hincks then goes back to the time of the seventeenth or eighteenth dynasty, and endeavours to show that the Turin Book of Kings, which he refers to that period, recognises the wandering year of 365 years, as well as the year of 360 days, which is always meant in the Turin Papyrus when a year is spoken of. He observes that the 2291 years, four months, and twenty days, which the Papyrus gives as the length of the reigns of the sovereigns whom it enumerates, if they be reduced to days, at the rate of 360 in the year, give *precisely* 2250×365. He observes, also, that if 2260 be subtracted from 3555, which Manetho states to be the number of years between the accession of Menes and the final conquest of Egypt by Ochus, the remainder is 1295, the *precise* number of years which elapsed between the accession of the seventeenth dynasty and the conquest of Egypt by Ochus, according to the restoration of the text of Manetho which Dr. Hincks had put forward in January, 1863. He maintains that 1634 B. C. (1295 years before Ochus), is the *historic* date of the accession of the seventeenth dynasty; but demurs to the 2260 years alleged to have intervened between it and the accession of Menes, as it does not yet appear on what grounds this number was fixed upon by the Egyptians of the sixteenth or seventeenth century B. C. There is good reason, he says, for thinking that some kings mentioned in the Papyrus were contemporary with others; and, as yet, there is no proof that in making this calculation the Egyptians allowed for their being so. He observes that the seventeenth dynasty of Manetho is not represented in the Papyrus of

Turin, nor is any that follows it; but all the preceding dynasties, which the Papyrus recognised as real and distinct, have their kings recorded in it. The Papyrus, however, has only ten of the sixteen dynasties of Manetho—namely, the first, the second; the third and fourth, thrown into one; the fifth, the sixth, the eighth, the eleventh, the twelfth, the thirteenth, and the Shepherds. Dr. Hincks believes that the whole of the second, and the greater part of the first and fifth dynasties of Manetho, were contemporary with the third and fourth; and has great doubts whether the eighth and eleventh, and again the thirteenth and the Shepherds, were not to some extent contemporaneous.

The Sothic, or sacred year, is then considered; and it is shown that it began on the 21st July in the two years before the Augustan bissextile, and on the 20th in the bissextile year and that which next followed it. It began on the same day with the civil year in the four years, A. D. 134, 135, 136, and 137, deviating from it in A. D. 138, when the civil year began on the sixth of the epagomenæ. This was counted as the first year of the 3rd canicular cycle, the other two having commenced on the 20th July, B. C. 2783, and 1323. The Sothic year must have superseded the still older year which began at the summer solstice, or at the beginning of the inundation, when this event occurred at the heliacal rising of Sothis—that is, as very roughly calculated, about 3200 B. C.

The Egyptians had also, it is next observed, a lunar year, beginning at the new moon which next followed the summer solstice. This year was of very great antiquity, and was in use at the same time with the better known, fixed, and moveable years already spoken of. Dr. Hincks thinks that there was also a wandering lunar year, like that now used by the Mahometans, in use in Egypt. It seems to be referred to in some very ancient inscriptions, and also in the Calendar of Esneh, in which three days are mentioned as new year's days, and on that account observed as festivals. M. Brugsch only attempts to explain one of these; M. Mariette differs as to this from M. Brugsch, but attempts to explain a second. Dr. Hincks maintains that MM. Brugsch and Mariette have not only failed to explain all the commencements of years, but have given false explanations where they gave any. He explains all the dates as follows:—Supposing that the calendar belongs to the Sothic year which began 21st July, A. D. 103, the first day of this was a double festival, being the commencement both of the Sothic year and the regular lunar year. The ninth day of the year, 29th July, A. D. 103, was the first *Thoth* of the civil year; and the 296th day of the year, ten lunations after the first, was the commencement of the wandering lunar year, 11th May, A. D. 104. The 21st July, A. D. 103, was the neomenia, according to the Egyptians, the conjunction of the sun and moon occurring that evening. A Karnac inscription of the Ptolemaic period speaks of the moon god being conceived on the first day of the month, born on the second, and attaining his maturity, or beginning to decay, on the 15th. These three month dates refer, of course, to the conjunction, first appearance, and plenitude of the moon. The 16th of the lunar month was oftener than the 15th regarded as the day of full moon; and two monthly festivals, celebrated on the 1st and 16th, have been rightly referred by Lepsius to the lunar year.

Dates of the lunar year are, according to Dr. Hincks, occasionally met with on the monuments. Such dates are, he thinks, those of the 1st and 16th of Athyr, of the 11th of Amenhotap III., mentioned on a scarabæus, so as to imply that the Nile was then rising, and near its height. The date of the Exodus in the month Abib, presumably Epiphi, is also referred to a lunar year. The month Abib is identified with what was afterwards the first month of the Israelites, and was, therefore, like this, a lunar month; and we know that it was the month which began at the new moon following the vernal equinox. Epiphi was the eleventh Egyptian month; the lunar Epiphi would, therefore, begin more than 295 days after the solstice, while the vernal equinox was about 271 days after it. From this it follows that the first Hebrew month would in general coincide with Payni, the tenth Egyptian month; but that it would occasionally coincide with Epiphi—namely, when the new moon followed the summer solstice very closely. This would furnish a means of determining the year of the Exodus accurately, if it were known approximately; for example, 1491 B. C. could not be the year of the Exodus, but 1494 B. C. might. But, what is of more consequence, the remark respecting the month Abib is a very strong argument in favour of the genuineness of the Biblical account of the Exodus, which has been recently called in question. No forger of a later age, and who had not lived in Egypt, could have thought of making such a statement.

The President read a paper, by Professor Sylvester, "On the Demonstration of Newton's Theorem respecting the Imaginary Roots of Equations."

The PRESIDENT read the following paper, with a NOTE by the late Sir W. R. HAMILTON, LL. D.:—

ON A THEOREM RELATING TO THE BINOMIAL COEFFICIENTS.

TOWARDS the end of March, I communicated the following theorem to Sir William Rowan Hamilton:—

$$\begin{aligned} \text{Putting } s_0 &= n_0 + n_3 + n_6 + \text{\&c.}, \\ s_1 &= n_1 + n_4 + n_7 + \text{\&c.}, \\ s_2 &= n_2 + n_5 + n_8 + \text{\&c.}, \end{aligned}$$

where n_0, n_1, &c., are the coefficients of the development

$$(1 + x)^n = n_0 x^0 + n_1 x^1 + n_2 x^2 + \text{\&c.},$$

and n is a positive whole number;

we shall find that, of the three quantities, s_0, s_1, s_2, two are always equal, and the third differs from them by unity.

I mentioned at the same time that I had arrived at theorems, analogous, but less elegantly expressed, by summing the series formed by taking every *fourth* or *fifth* coefficient, and so on, in the binomial development; and I asked Sir William R. Hamilton whether he remembered to have seen these theorems stated anywhere. I thought it likely that the well-known elementary theorem respecting the equality of the sums of the alternate coefficients in the binomial development would have suggested research in this direction. In a note, written on the day on which he received mine, Sir William stated that my theorem was new to him, and that he had proved it by the help of imaginaries and determinants. The following day he wrote again to me, furnishing me with the following more precise statement of my theorem:—

"Let ν and N be the following (whole) functions of n,

$$\nu=(-1)^n,\quad N=\tfrac{1}{3}(2^n-\nu);$$

then N, N and $N+\nu$ are *always* the value of the *three sums*, *if suitably arranged;* and the *singular sum* is s_0, or s_1, or s_2, according as n, or $n+1$, or $n+2$ is a multiple of 3."

I communicated the following demonstration of my theorem to Sir William, in a letter of the 29th March:—

Using the notation employed above, we know that

$$(n+1)_r = n_r + n_{r-1},$$

$$(n+1)_{r-1} = n_{r-1} + n_{r-2},$$

$$\text{and } (n+1)_r - (n+1)_{r-1} = n_r - n_{r-2}.$$

Now, putting $s_r = \ldots\ldots + n_{r-m} + n_r + n_{r+m} + \ldots\ldots,$

$$s'_r = \ldots\ldots + (n+1)_{r-m} + (n+1)_r + (n+1)_{r+m} + \ldots\ldots,$$

(m being any positive integer),

we have, from equation (1),

$$s'_r - s'_{r-1} = s_r - s_{r-2};$$

and, in the particular case under consideration, viz. $m = 3$,

$$s'_2 - s'_1 = s_2 - s_0,$$

$$s'_1 - s'_0 = s_1 - s_2,$$

$$s'_0 - s'_2 = s_0 - s_1.$$

Thus it appears that the *differences* of the quantities s'_0, s'_1, s'_2, are equal in magnitude, but of opposite signs to those of s_1, s_2, s_0; and if we form these differences for successive values of n, they will arrange themselves in a cycle of six. Thus, if

$$s_2 - s_1 = \Delta_0,\ s_1 - s_0 = \Delta_2,\ s_0 - s_2 = \Delta_1,$$

we might form the following Table.

n	Δ_0	Δ_2	Δ_1
1	-1	0	1
2	-1	1	0
3	0	1	-1
4	1	0	-1
5	1	-1	0
6	0	-1	1
7	-1	0	1
8	-1	1	0
. .	. .	. .	. .

Combining this result with the well-known theorem—

$$s_0 + s_1 + s_2 = n_0 + n_1 + n_2 + \ldots\ldots = 2^n,$$

we arrive at formulæ for s_0, s_1, s_2.

A couple of days later, I communicated to Sir William Hamilton my statement and proof of the corresponding theorem respecting the four sums obtained by adding every fourth binomial coefficient.

The theorem is as follows :—

"Writing $\nu = (-1)^i$ where i is any positive integer,

If n is of the form $4i$,

$$s_0 = 2^{n-2} + \nu\, 2^{\frac{n-2}{2}},$$
$$s_1 = 2^{n-2},$$
$$s_2 = 2^{n-2} - \nu\, 2^{\frac{n-2}{2}},$$
$$s_3 = 2^{n-2};$$

If n is of the form $4i + 1$,

$$s_0 = 2^{n-2} + \nu\, 2^{\frac{n-3}{2}},$$
$$s_1 = 2^{n-2} + \nu\, 2^{\frac{n-3}{2}},$$
$$s_2 = 2^{n-2} - \nu\, 2^{\frac{n-3}{2}},$$
$$s_3 = 2^{n-2} - \nu\, 2^{\frac{n-3}{2}};$$

If n is of the form $4i+2$,

$$s_0 = 2^{n-2},$$
$$s_1 = 2^{n-2} + \nu\, 2^{\frac{n-2}{2}},$$
$$s_2 = 2^{n-2},$$
$$s_3 = 2^{n-2} - \nu\, 2^{\frac{n-2}{2}};$$

If n is of the form $4i+3$,

$$s_0 = 2^{n-2} - \nu\, 2^{\frac{n-3}{2}},$$
$$s_1 = 2^{n-2} + \nu\, 2^{\frac{n-3}{2}},$$
$$s_2 = 2^{n-2} + \nu\, 2^{\frac{n-3}{2}},$$
$$s_3 = 2^{n-2} - \nu\, 2^{\frac{n-3}{2}}."$$

The proof of this rests upon the equations

$$s'_3 - s'_2 = s_3 - s_1,$$
$$s'_2 - s'_1 = s_2 - s_0,$$
$$s'_1 - s'_0 = s_1 - s_3,$$
$$s'_0 - s'_3 = s_0 - s_2,$$

combined with $s_0 + s_1 + s_2 + s_3 + 2^n$.

Though the theorems which I have now stated or indicated are not devoid of interest, I should hardly have brought them under the notice of the Academy if they had not led Sir William R. Hamilton to discuss the more general question treated of in the Note appended to this paper. It is at his suggestion that I have communicated the substance of the letter which I addressed to him on this subject.

I may be allowed to add, that the first theorem stated in this paper was suggested by the investigation of a very simple geometrical problem, and that I have found that it admits of being very curiously illustrated by means of my theory of algebraic triplets.

EXTRACT *from a recent Manuscript Investigation, suggested by a Theorem of* DEAN GRAVES, *which was contained in a Letter received by me a week ago.*

1. Let n_r, for any whole value not less than zero of n, and for *any* whole value of r, be defined to be the (always whole) coefficient of the power

x^r, in the expansion of $(1+x)^n$ for an arbitrary x; so that we have always $n_0 = 1$, but $n_r = 0$ in each of the two cases, $r < 0$, $r > n$.

2. Let p be any whole number > 0; and let the sum of all the coefficients n_m, for which $m \equiv r$ (mod. p), the value of n being given, be denoted by the symbol,

$$s^{(p)}_{n,r};$$

which thus represents, when n and p are given, a periodical function of r, in the sense that

$$s^{(p)}_{n,r} = s^{(p)}_{n,r+tp},$$

if t be *any* whole number (positive or negative).

3. A fundamental property of the binomial coefficient n_r is expressed by the equation,

$$(n+1)_r = n_r + n_{r-1};$$

from which follows at once this analogous *equation in differences*,

$$s^{(p)}_{n+1,r} = s^{(p)}_{n,r} + s^{(p)}_{n,r-1};$$

with the p *initial values*,

$$s^{(p)}_{0,0} = 1,\ s^{(p)}_{0,1} = 0,\ s^{(p)}_{0,2} = 0,\ \ldots\ s^{(p)}_{0,p-1} = 0.$$

4. Hence may be deduced the *general expression*,

$$s^{(p)}_{n,r} = p^{-1}\,\Sigma x^{-r}(1+x)^n;$$

in which the summation is to be effected with respect to the p roots x, of the binomial equation,

$$x^p - 1 = 0.$$

5. The summand *term*,

$$x^{-r}(1+x)^n,$$

usually involves *imaginaries*, which must however disappear in the *result*; and thus the general expression for the *partial sum*, s, may be reduced to the *real* and *trigonometrical form*,

$$s^{(p)}_{n,r} = p^{-1}\,\Sigma\left(2\cos\frac{m\pi}{p}\right)^n \cos\frac{m(n-2r)\pi}{p},$$

with the verification that

$$0 = \Sigma\left(2\cos\frac{m\pi}{p}\right)^n \sin\frac{m(n-2r)\pi}{p};$$

each summation being performed with respect to an auxiliary integer from $m = 0$ to $m = 1$.

6. Accordingly, *without* using *imaginaries*, it is easy to prove that this expression (5) satisfies all the recent conditions (3), and is therefore a correct expression for the partial sum

$$s^{(p)}_{n,r};$$

while a similar proof of the recent equation $0 = \&c.$

7. But to form *practically*, with the easiest possible *arithmetic*, a *Table of Values* of s, for any given *period*, p, we are led by No. 3 to construct a *Scheme*, such as the following:—

TABLE OF VALUES OF $s^{(5)}_{n,r}$.

	$r = 5$	4	3	2	1	0	Verification.
$n = 0$	$s = 1$	0	0	0	0	1	$\Sigma s = 1$
1	1	0	0	0	1	1	2
2	1	0	0	1	2	1	4
3	1	0	1	3	3	1	8
4	1	1	4	6	4	1	16
5	2	5	10	10	5	2	32
6	7	15	20	15	7	7	64

The PRESIDENT read the following paper by the late Sir WILLIAM R. HAMILTON:—

ON A NEW SYSTEM OF TWO GENERAL EQUATIONS OF CURVATURE, the *Commentationes Recentiores*, but of which a Latin reprint has been since very judiciously given, near the beginning of the Second Part (Deuxième Partie, Paris, 1850) of LIOUVILLE's *Edition* of* MONGE, it still appears that there is room for some not useless Additions to the Theory of *Lines* and *Radii* of *Curvature*, for *any given Curved Surface*, when treated by what Gauss calls the *Second Method* of discussing the *General Properties of Surfaces*. In fact, the *Method* here alluded to, and which consists chiefly in treating the *three* co-ordinates of the *surface* as being so many *functions* of *two* independent variables, does not seem to have been used *at all* by Gauss, for the determination of the *Directions of the Lines of Curvature;* and as regards the *Radii of Curvature* of the *Normal Sections* which *touch* those *Lines* of Curvature, he appears to have employed the *Method*, *only for the Product*, and *not also* for the *Sum*, of the *Reciprocals*, of those *Two Radii*.

2. As regards the *notations*, let x, y, z be the rectangular co-ordinates of a point P upon a surface (S), considered as *three* functions of *two* independent variables, t and u; and let the 15 partial derivatives, or 15 partial differential coefficients, of x, y, z taken with respect to t and u, be given by the nine differential expressions.

$$(a) \,.\,.\, \begin{cases} dx = x'dt + x_{,}du; \;\; dx' = x''dt + x_{,}'du; \;\; dx_{,} = x_{,}'dt + x_{,,}du; \\ dy = y'dt + y_{,}du; \;\; dy' = y''dt + y_{,}'du; \;\; dy_{,} = y_{,}'dt + y_{,,}du; \\ dz = z'dt + z_{,}du; \;\; dz' = z''dt + z_{,}'du; \;\; dz_{,} = z_{,}'dt + z_{,,}du. \end{cases}$$

3. Writing also, for abridgment,

$$(b) \,.\,.\, e = x'^2 + y'^2 + z'^2; \;\; e' = x'x_{,} + y'y_{,} + z'z_{,}; \;\; e'' = x_{,}^2 + y_{,}^2 + z_{,}^2$$

we shall have (c) . . $ee'' - e'^2 = K^2$, if (d) . . $K^2 = L^2 + M^2 + N^2$,

and (e) . . $L = y'z_{,} - z'y_{,}; \;\; M = z'x_{,} - x'z_{,}; \;\; N = x'y_{,} - y'x_{,};$

so that (f) . . $Lx' + My' + Nz' = 0, \;\; Lx_{,} + My_{,} + Nz_{,} = 0.$

Hence $K^{-1}L$, $K^{-1}M$, $K^{-1}N$ are the *direction-cosines* of the *normal* to the surface (S) at P; and if x, y, z be the co-ordinates of any *other* point Q of the same normal, we shall have the equations,

$$(g) \,.\,.\, K(X-x) = LR; \;\; K(Y-y) = MR; \;\; K(Z-z) = NR;$$

with (h) . . $R^2 = (X-x)^2 + (Y-y)^2 + (Z-z)^2;$

where R denotes the normal line PQ, considered as changing sign in passing through zero.

4. The following, however, is for some purposes a more convenient *form* (comp. (f)) of the *Equations of the Normal;*

$$(i) \,.\,.\, (X-x)x' + (Y-y)y' + (Z-z)z' = 0;$$

$$(j) \,.\,.\, (X-x)x_{,} + (Y-y)y_{,} + (Z-z)z_{,} = 0.$$

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* The foregoing dates, or references, are taken from a note to page 505 of that Edition.

Differentiating these, as if X, Y, Z were constant, that is, treating the point Q as an intersection of two consecutive normals, we obtain these two other equations,

$$\text{(k)} \,..\, \begin{cases} (X-x)dx' + (Y-y)dy' + (Z-z)dz' = x'dx + y'dy + z'dz; \\ (X-x)dx_, + (Y-y)dy_, + (Z-z)dz_, = x_,dx + y_,dy + z_,dz. \end{cases}$$

If, then, we write, for abridgment,

$$\text{(l)} \,..\, \begin{cases} v = du : dt; & E = Lx'' + My'' + Nz''; \\ E' = Lx_,' + My_,' + Nz_,'; & E'' = Lx_{,,} + My_{,,} + Nz_{,,}; \end{cases}$$

we shall have, by (a) (b))g), the two important formulæ:

$$\text{(m)} \,..\, R\,(E + E'v) = K\,(e + e'v); \quad R\,(E' + E''v) = K\,(e' + e''v);$$

which we propose to call the two general *Equations of Curvature.*

5. In fact, by elimination of R, these equations (m) conduct to a *quadratic in* v, of which the roots may be denoted by v_1 and v_2, which first presents itself under the form,

$$\text{(n)} \,..\, (e + e'v)\,(E' + E''v) = (e' + e''v)\,(E + E'v),$$

but may easily be thus transformed,

$$\text{(o)} \,..\, \begin{cases} Av^2 - Bv + C = 0, \text{ or } Adu^2 - Bdtdu + Cdt^2 = 0, \\ \text{with } A = e'E'' - e''E', \ B = e''E - eE'', \ C = eE' - e'E; \end{cases}$$

so that we have the following *general relation*,

$$\text{(p)} \,..\, eA + e'B + e''C = 0,$$

(of which we shall shortly see the geometrical signification), between the *coefficients*, A, B, C, of the *joint differential equation* of the system of the two *Lines of Curvatare* on the surface.

6. The root v_1 of the quadratic (o) determines the *direction* of what may be called the *First Line of Curvature*, through the point P of that surface; and the *First Radius of Curvature*, for the same point P, or the radius R_1 of curvature of the *normal section* of the surface which *touches* that *first line*, may be obtained from *either* of the two equations (m), as the value of R which corresponds in that equation to the value v_1 of v. And in like manner, the *Second Radius of Curvature* of the same surface at the same point has the value R_2, which answers to the value v_2 of v, in each of the same two *Equations of Curvature* (m). We see, then, that this *name* for those two equations is justified by observing that when the two independent variables t and u are given or known; and therefore also the seven functions of them, above denoted by e, e', e'', E, E', E'', and K. The equations (m) are satisfied by *two* (but *only two*) *systems* of values, v_1, R_1, and v_2, R_2, of (I.) the *differential quotient* v, or $\frac{du}{dt}$, which determines the *direction* of a *line of curvature* on the surface; and (II.) the symbol R, which determines (comp. No. 4) at once the length and the *direction*, of the *radius of curvature* corresponding to that [illegible]

7. Instead of eliminating R between the two equations (m), we may *begin* by eliminating v; a process which gives the following quadratic in R^{-1} (the curvature):—

$$(q) \;.\,.\; (eR^{-1} - eK^{-1})\,(e''R^{-1} - e''\,K^{-1}) = (e'R^{-1} - eK^{-1})^2;$$

$$\text{or } (r) \;.\,.\; R^{-2} - FR^{-1} + G; \text{ where (because } ee'' - e'^2 = K^2\text{)},$$

$$(s) \;.\,.\; F = R_1^{-1} + R_2^{-1} = (eE'' - 2e'E' + e''E)\,K^{-3}, \text{ and}$$

$$(t) \;.\,.\; G = R_1^{-1}R_2^{-1} = (EE'' - E'^2)K^{-4}.$$

We ought, therefore, as a *First General Verification*, to find that this last expression, which may be also thus written,

$$(u) \;.\,. \qquad G = R_1^{-1}R_2^{-1} = \frac{EE'' - E'E'}{(L^2 + M^2 + N^2)^2},$$

agrees with that reprinted in page 521 of Liouville's Monge, for what Gauss calls the *Measure of Curvature* (k) of a *Surface;* namely,

$$(v) \;.\,. \qquad k = \frac{DD'' - D'D'}{(AA + BB + CC)^2};$$

which accordingly it evidently does, because our symbols $L\ M\ N\ A\ B\ C$ represent the combinations which he denotes by ABCD D'D''.

8. As a *Second General Verification*, we may observe that if I be the *inclination* of any *linear element*, $du = vdt$, to the *element* $du = 0$, at the point P, then

$$(w) \;.\,.\; \tan \mathrm{I} \qquad \frac{Kv}{e + e'v};$$

and therefore, that if H be the *angle* at which the *second crosses the first*, of *any two lines* represented *jointly* by such an equation as

$$(x) \;.\,.\; Av^2 - Bv + C = 0, \text{ with } v_1 \text{ and } v_2 \text{ for roots, then}$$

$$(y) \;.\,.\; \tan H = \tan\,(I_2 - I_1) = \frac{K(B^2 - 4AC)^{\frac{1}{2}}}{eA + e'B + e''\,C};$$

so that the *Condition of Rectangularity* ($\cos H = 0$), for any *two* such lines, may be thus written:

$$(z) \;.\,. \qquad eA + e'B + e''\,C = 0.$$

But this *condition* (z) had already occurred in No. 5, as an equation (p) which is satisfied generally by the *Lines of Curvature;* we see therefore anew, by this analysis, that those *lines* on *any surface* are in general (as is indeed well known) *orthogonal* to each other.

9. Finally, as a *Third General Verification*, we may assume x and y *themselves* (instead of t and u), as the two independent variables of the problem, and then, if we use *Monge's Notation* of p, q, r, s, t, we shall easily recover all his leading results respecting *Curvatures of Surfaces*, but by transformations on which we cannot here delay.

The following donations were presented:—From

1. E. W. Doyle, Esq., a perfect heptagonal stone quern, and three flint arrow heads.

2. Stanhope Kenny, Esq., a mass of bog butter, found enveloped in the skin of some animal.

3. H. W. Westropp, Esq., his Treatise "On the Fanaux de Cimetières in France, and the Round Towers in Ireland."

4. John T. Gilbert, Esq., Librarian to the Academy, his work entitled "History of the Viceroys of Ireland," Vol. I.

The thanks of the Academy were voted to the donors.

MONDAY, NOVEMBER 13, 1865.

John Francis Waller, LL. D., Vice-President, in the Chair.

The Secretary reported that a Collection of about 100 Books and 50 Manuscript Volumes had been deposited in the Library of the Academy, agreeably to the will of the late W. Smith O'Brien, Esq.

The Secretary presented the following donations:—From

1. George V. Du Noyer, Esq., a stone Sundial, found in the Churchyard of Kilbeg, near Kells.

2. John Evans, Esq., of Nash Mills, three nuclei of worked Flint, from Pressigny-le-grand.

3. G. H. Kinahan, Esq., a highly finished stone Celt, found a little north of Oughterard, county of Galway.

4. Robert Day, Jun., Esq., a stone Celt, and two flint Lance Heads, found at Toome Bar, county of Antrim.

5. The Rev. John Keleher, P. P., a small brass Box, for holding standard Weights, found near Kinsale.

6. Richard Palmer Williams, Esq., a collection of 327 Autographs, from the addresses of franked Letters, delivered in Dublin.

7. The Secretary also presented some rudely carved circular pieces of Coal found in graves, at Portpatrick, in Galloway.

The thanks of the Academy were voted to the several donors.

The Librarian brought up the Resolution of the Council of Monday, the 6th November—"That the Council do recommend to the Academy to authorize the opening of a Subscription List for the purchase of the MS. Collections of the late John Windele, of Cork;" whereupon it was resolved,

That this recommendation be adopted by the Academy.

MONDAY, NOVEMBER 30, 1865.—STATED MEETING.

THE VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The President delivered the following Address on the loss sustained by the Academy in the death of Sir W. R. Hamilton.

ADDRESS.

GENTLEMEN,—The death of SIR WILLIAM ROWAN HAMILTON, Andrews' Professor of Astronomy, Astronomer Royal of Ireland, for thirty-eight years a most distinguished member of the Royal Irish Academy, and formerly its President, was an event which could not be allowed to pass without public notice in this place. There was not one of his brother Academicians who did not look up to him with reverence on the ground of his wonderful genius, the vastness of his attainments, and the number and importance of his discoveries. And there were amongst us not a few bound to him by ties of an intimate friendship, who had watched his brilliant career with an affectionate sympathy, and rejoiced as each new conquest which he achieved in the fields of Science earned for him fresh laurels and a more extended fame. It is not strange, therefore, that his recent death should be lamented by all of us as a loss almost irreparable to Science, whilst within the circle of his friends it is deplored with a profound and lasting sorrow. These feelings demanded utterance. I should have been unfaithful in the performance of my duty as President—I should have been untrue to the convictions of my understanding and my heart—if I had not endeavoured to express them. If the expression be inadequate, I trust you will make allowance for the shortcomings of a speaker overpowered at once by the greatness of his theme, and by the consciousness of his inability to do justice to it.

It is not my intention here to present to you even a biographical sketch of HAMILTON or a complete outline of his character. Merely to enumerate his works, and to state with adequate fulness their subjects, would demand more time than is at our disposal. It must suffice if I bring before you the turning points in the history of his life, and briefly recall to your recollection his principal achievements as a Mathematician. Born in August, 1805, in the house of his father, Mr. Archibald Hamilton, in Dominick-street, Dublin, he gave from his infancy indications of the possession of extraordinary powers; and they were not left without wise and diligent culture. His father consigned him when less than three years old to the care of his uncle, the Rev. James Hamilton, of Trim, formerly a member of this Academy, and a contributor to its "Transactions." Under the tuition of this affectionate and able instructor he carried on his studies till he became an undergraduate in Trinity College in 1823. His career there was a most brilliant one. In every kind of trial he distanced his competitors, and justified all the expectations of his friends. But, whilst thus engaged in collegiate exercises of a comparatively elementary nature, he was already entering upon studies of greater range and elevation. A year before he entered College he had drawn up, and communicated to Dr. Brinkley, then President of this Academy, a paper on Caustics, which was the germ of that "Theory of Systems of Rays," the publication of which first rendered HAMILTON's name celebrated amongst mathematicians. Brinkley encouraged the youthful author by his kindness, and guided him by his counsel. He communicated the paper on Caustics to the Academy, before which it was read in December, 1824, and referred to a Committee, consisting of Dr. Mac Donnell, Mr. Harte, and Dr. Lardner. Their report bore testimony to the novelty and value of the results, and the analytic skill displayed in the conduct of the investigations; but recommended the author to give a fuller development to the processes and reasonings by which his formulæ and conclusions were arrived at. Acting on this advice, he employed himself in the intervals of collegiate study in recasting and enlarging his paper, which was anew presented to the Academy, under the title of "Theory of Systems of Rays," on the 23rd of April, 1827. This memoir was in itself of the highest interest and value; so comprehensive in its method as to extend unlimitedly, and with universal success, over the whole field of optics. It also contained the germs of thought which developed themselves in works which afterwards gained for HAMILTON the highest distinction. Its table of contents announced an intention of publishing in the third part of the essay an application to dynamics of the same general principle, of which the application to optics was thus in part made public; and its third supplement contains the announcement of HAMILTON's remarkable discovery of Conical Refraction.

The Professorship of Astronomy in Trinity College became vacant in the year 1827, on the promotion of Dr. Brinkley to the Bishopric of Cloyne. Perhaps there was no incident in the life of HAMILTON more remarkable than his selection at that time to fill Brinkley's place. An undergraduate of one-and-twenty, he was preferred to rival candidates of high qualifications and influence, and the decision of the University authorities in making the appointment was ratified by the judgment of the public. It seemed to be self-evident that a man who had given such proofs of the possession of a transcendant power in dealing with the most abstract questions in mathematical physics must be the worthy and rightful successor of Brinkley. As Professor of Astronomy, two spheres of exertion belonged to him—that of lecturer upon the science, and that connected with the practical working of the Observatory. Those who have attended his lectures can bear witness to their merit. They were full of practical teaching, and calculated by their eloquence to excite in their hearers an enthusiasm for the study which they were intended to illustrate. For the business of the Observatory, it must be admitted that HAMILTON was not equally well fitted. The bias of his genius was undoubtedly to pure mathematics; but, if we estimate the total amount and value of the work which he has done—the impulse which he has given to the whole of mathematical science—we shall see little reason to find fault with that decision by which he was placed in the professorial chair, and sustained in the possession of it.

It was in 1834 that HAMILTON received the Cunningham Medal of this Academy, and the Royal Medal of the Royal Society, as the reward of his discovery of Conical Refraction. This is admitted to have been one of the most remarkable scientific predictions that was ever made—one which announced, on the foundation of pure mathematical calculation, a physical phenomenon which was suggested by no analogy, and seemed beyond the boundaries of probability; but which, as you know, was completely verified by the experiments of Professor Humphrey Lloyd.

In 1837 HAMILTON was elected President of this Academy, on the death of Dr. Bartholomew Lloyd, who had occupied the chair for the two years succeeding the death of Brinkley. His inaugural address gave evidence of his power to direct the operations of a learned society constituted as ours is. He showed that he entered into the working of all its departments, and could sympathize with the labours of all its members. For eight years, during which he held this office, he exerted himself in every way to increase the usefulness of the Academy, and to sustain its honour; and, when he resigned the Presidentship, he received the cordial thanks of the Academicians "for his high and impartial bearing in the chair, and for his untiring efforts to advance the interests of the body."

We have already mentioned HAMILTON's paper on a "General Method in Dynamics." In this memoir, starting from the idea of a characteristic function, analogous to that employed in his essay on Systems of Rays, he succeeded in giving a system of complete and rigorous integrals of the celebrated differential equations of motion of a system of bodies. This achievement gained for him the Medal of the Royal Society, and the recognition of the greatest European mathematicians. The next great work of HAMILTON of which we have to make mention, is his paper on "Algebra considered as the Science of pure Time," a treatise of a peculiar and semi-metaphysical kind. His object in the composition of it was to establish the foundations of algebra as a science, rather than to improve its processes as an art, or to perfect its symbolism as a language. With this was connected his theory of conjugate functions, or algebraic couples, to which he was conducted in his attempts to explain some remarkable results stated by my brother, Mr. John Graves, in a paper upon imaginary logarithms. We now, in this rapid summary, pass on to his last great invention—that of the Calculus of Quaternions. Its elaboration has occupied the last twenty-two years of his life. During that time he has employed this new and powerful *organon* in discussing questions in almost every branch of mathematics. Most of his attention has, no doubt, been given to geometrical applications. But he has not failed to record in our "Proceedings" results of researches, showing that the new calculus adapts itself to the requirements of physical science. He has shown how perfectly it enables us to conceive and express, in its peculiar language, the mathematical problem of determining the orbits and perturbations of bodies governed in their motions by the Newtonian law of force. He has also shown that quaternion equations may be advantageously employed in the discussion of Fresnel's wave surface.

I have not attempted to make a complete catalogue even of all his most important works; I have said nothing of his papers on Fluctuating

Functions; on the Calculus of Probabilities; on the Calculus of Principal Relations; on the Argument of Abel to prove the Insolubility of Equations of the Fifth Degree; on Differences of Zero; on Geometrical Nets in Space. Any one of these memoirs would have been sufficient to make the reputation of a mathematician.

Hamilton was gifted with a rare combination of those qualities which are essential instruments of discovery. He had that fine perception of analogy by which the investigator is guided in his passage from the known to the unknown. This is an instrument by which many important mathematical discoveries have been effected. Sometimes the mathematician devises some happy modification in the statement of a theorem or a method, by which its application may be extended. Sometimes, by analyzing different demonstrations, he even sees that a particular proposition may be made the starting point from which he ascends to more than one generalization. In the investigations of Hamilton we find abundant instances of the skilful use of all the ordinary expedients and instruments of inventive sagacity. But he seems, also, to have possessed a higher power of divination—an intuitive perception that new truths lay in a particular direction, and that patient and systematic search, carried on within definite limits, must certainly be rewarded by the discovery of a path leading into regions hitherto unexplored. Something like this was the unshaken assurance which led Columbus to turn his back upon Europe, to launch upon the broad Atlantic, and seek a New World in the far-off West.

And our illustrious countryman's diligence in research was not less admirable than his prescient sagacity. No amount of labour to be incurred could deter him from entering upon the calculations by which the correctness of his conjectures was to be tested. The confident expectation of obtaining results instructive in one way or another reconciled him to the irksomeness of the most tedious and complicated calculations. He felt that the great object to be sought, in the first instance, was the discovery of the result itself; and he trusted that, once it was reached, he would be able to strike out some more direct and more elegant method of investigation. His MSS., even his published researches, furnish many examples of this. Once he had reached the conclusion at which he had been aiming, he resumed the consideration of the principal steps in his argument; he interpreted them with care; he traced their connexion, and seldom failed to arrive at simplifications and generalizations, which amply compensated for the labour spent upon his first essays. By this habit of grappling courageously with the difficulties of calculation he was distinguished from some other eminent mathematicians. Averse to plunge into depths of calculation from which they see no certain hope of emerging in the end, they are tempted to expend an undue amount of intellectual energy in the endeavour to force their way by a direct method to the desired result.

Whilst touching on this point, I cannot help reverting to another mathematician of whom Ireland is justly proud—the late Professor Mac Cullagh. I have seen him sit for hours with his paper before him, and all the outline of an elaborate investigation placed upon it. All the while he never took up his pen to execute the work which he had planned. He continued to brood over his task, and scanned it on every side, in the hope of being able to avoid the necessity of going through some "sea of trouble," in the shape of lengthened analytical computations. His taste in mathematics was refined—almost fastidious; and he could not bring himself to look with approval upon any demonstration which appeared wanting in symmetry and elegance. I must not be understood as in the least depreciating Mac Cullagh's power and skill in calculation. His researches in physical optics prove that he possessed these qualities in the highest degree. I only state the fact, that he sometimes was tempted to subject his faculty of mathematical insight to a painful and dangerous strain, in order to avoid the irksomeness of labour that was little more than mechanical.

In the case of HAMILTON, it is, moreover, deserving of notice, that he evinced a readiness to grapple with the difficulties of calculation, even where there was no prospect of his labour being rewarded by any discovery. He engaged in exercises of this kind sometimes from a wish to strengthen his intellectual hold of general propositions by scrutinizing the results obtained, by applying them in a number of particular instances; and sometimes, perhaps, from a wish to mature and keep in exercise those powers of calculation upon the exactitude and prompt operation of which so much depends in the conduct of difficult mathematical investigations. I have known him spend hours, or even days, in working numerical examples of some theorem in pure or applied mathematics, or in testing the accuracy of some formula of approximation. Occasionally he engaged in tasks of this nature, in the kindly endeavour to convince some half-crazed squarer of the circle that his proposed construction was inaccurate. Finding almost always that it was hopeless to convince the mathematical fanatic of the unsoundness of any of his premises, he would take pains to show him that the results he obtained were false in particular instances.

And this leads me to notice a feature in his character which deserves to be recorded. From the lofty height of his genius and learning he was accustomed to stoop with the utmost readiness to hold intellectual converse with inferior minds. Many of his visitors at the Observatory, and the members of the class who attended his lectures in Trinity College, can recall instances of his patience and good nature in answering their questions, and clearing up the difficulties which beset them in their elementary studies of mathematics and natural philosophy.

It is remarkable that, while he possessed such powers of calculation, and was almost prodigal in the exercise of them, he was to the last degree solicitous about the metaphysics of every subject on which he undertook to write. We have seen a decisive instance of this tendency of his mind in his treatment of algebra considered as the science of pure time. So, again, in laying the foundation of his Calculus of Quaternions, we see him labouring to secure its stability by the most careful regard to the primary conceptions of time and space. Students of his lectures on Quaternions have sometimes complained that he has claimed from them too much attention to the metaphysics of the subject, and has stopped them in their career of building up, in order that they might contemplate afresh the plan of the structure. But this was in accordance with his views regarding the ascending scale of the subjects of human thought. To religion he gave the highest place, and this not as a formality; for his was a deeply reverential spirit. He assigned the next to metaphysics. To them he subordinated mathematics and poetry, and assigned the lowest place to physics and general literature. His studies in the department of metaphysics were extensive. After a thoughtful examination of Berkeley's writings, he professed himself a disciple of that philosopher, "with most cordial and delighted submission;" not, indeed, assenting to every separate argument, but embracing his grand results; and in this attachment to Berkeley's theory we have reason to know that he was confirmed by his converse with Faraday, who, in his own region of investigation, had been led to the conclusion that forces, rather than material particles, were the ultimate objects of physical inquiry. His acquaintance with the German language enabled him to master the works of Kant. In the reasonings of that philosopher he was the more ready to concur, as his own previous inquiries had already conducted him to several of Kant's views respecting the intuitions of time and space.

The literary attainments of HAMILTON were of a high order. At an early period of his life he gave surprising proofs of his power in acquiring languages; and though in after years he made but little display of these acquisitions, there can be no doubt but that his familiar acquaintance with the great Classic writers, and the ease with which he could read works written in the Continental languages, contributed to the culture of his taste and the force of his imagination, as well as to the facility with which he prosecuted studies of a professional kind. In the literary part of his Collegiate course he was not less eminent than in his scientific studies. He was a successful competitor on two occasions for the Vice-Chancellor's Prizes, proposed for the authors of English poems; and his examiners placed on record a judgment indicating their sense of his extraordinary proficiency in the Greek language, as well as a similar attestation of his remarkable attainments, for an undergraduate, in astronomical science. He continued all through his life the devotion to literature of which he gave these early proofs. He read widely, with an intense enjoyment of all that was excellent, and with the discrimination of a practised critic. With many of the distinguished authors of his time he was on terms of friendship: Miss Edgeworth, Mrs. Hemans, Wordsworth, Southey, and Coleridge were his friends and correspondents. With such tastes and associations, it was not to be wondered at if he, from time to time, gave vent to his poetic feelings in verse. These compositions were not mere prolusions—exercises in versification—the promptings of a vain desire to excel in walks different from those in which his chief distinctions had been gained. They were the genuine outpourings of a noble heart and fervid imagination, characterized by a depth of thought and elevation of sentiment which compensated for occasional defects in artistic execution. These poetic efforts have an additional interest, as exemplifying in his own productions the connexion which he so strongly insisted on as existing between the highest provinces of science and the region of poetry—in both of which he maintained that there was scope and demand for the exercise of the imaginative faculty. According to him, the modern geometry, which deals with the infinites and imaginaries of space, has its beauty and its fascination; and he reckoned the happy daring of such geometers as Poncelet and Chasles as closely allied to poetry. We happen to know that this view of his, as communicated by him to the poet Wordsworth, was to the latter an entirely new revelation, and had the effect of raising his conception, which had before been unduly depreciatory, of the dignity both of science itself, and of its most eminent votaries.

Literary and scientific men are often censured, and not without reason, for their want of capacity in the transaction of business. To this reproach HAMILTON was not liable. He had a retentive memory, which enabled him to keep himself familiar with matters of detail; and a love of method, which manifested itself in systematic arrangement of any work which he had to perform. I believe that there never was a President of this Academy who had such a minute acquaintance with its affairs—such an exact knowledge of its history and constitution; and, consequently, whenever questions arose respecting its laws and usages, he was generally able to solve them by an immediate reference either to established rules, or to the Minutes recording the acts of the Academy or its Council. Nor was he less remarkable for qualities as necessary in the post he occupied, and of greater moral worth—for graciousness, combined with truthfulness, for a perfect freedom from all unworthy jealousy, and for a just sense of the dignity of the body over which he was called to preside.

Of his efficiency in the transaction of public business he gave signal proof at the time of the first Meeting of the British Association of Science in Dublin. He took an active part, along with Dr. Lloyd and a few other distinguished men of science, in those preliminary movements by which the governing bodies of Trinity College and the Academy were induced to invite the British Association to hold its meeting in this city in the year 1835. On that occasion, being appointed one of the Secretaries for the year, he discharged the duties of his office with a zeal and efficiency which procured for him the cordial thanks of all who took part in the proceedings. It thus fell to his lot to prepare the Annual Address usually read at the first general meeting of the Association. In that Address, though it was delivered thirty years ago, many of you will remember with what eloquence he expounded the working of the social spirit in promoting the progress of science. He explained to the thousands who listened to him the means, the instruments, the processes which are contained in the operation of that spirit. He told them the men of science assembled there met and spoke and felt together then, that they might afterwards better think and act and feel alone. He told them that it is indeed the individual man who investigates and discovers—not any aggregate or mass of men; but, recognising in the fullest manner the necessity for individual exertion, and the ultimate connexion of every human act and human thought with the personal being of man, he forcibly reminded his hearers that the social feelings make up a large and powerful part of that complex and multiform being. "The affections," he said, "act upon the intellect; the heart, upon the head. In the very silence and solitude of its meditations, still genius is essentially sympathetic—is sensitive to influence from without, and fain would spread itself abroad, and embrace the whole circle of humanity." And then he proceeded to descant upon the influence which the love of fame exerts in quickening the efforts and cheering the labours of the greatest intellects. The passage is worthy of being referred to for its eloquence alone. But it has for us a special value; because it reveals to us something of the inmost mind of HAMILTON himself, and accounts for traits in his character which were not understood or viewed as indulgently as they ought to have been.

A mathematician endowed with such original powers as HAMILTON possessed might have been excused, if, yielding to the natural temptation of waiting for casual inspirations, he had carried on his labours in a desultory or unsystematic manner. To such temptations—and no doubt he felt them—he rose superior. He was, on the contrary, remarkable for the diligence and method with which he performed all his work. These qualities are evidenced by the number, magnitude, and importance of his published works. There was no minute care, even in matters of typographical nicety, which he disdained to expend upon them. And in his MS. books, carefully written, and with dates marking from day to day the progress of his scientific life, he recorded all his meditations, all the calculations through which he passed in his apparently fruitless, as well as in his most successful, researches. These volumes, many of them very large, and numbering about sixty, have been deposited in the Library of Trinity College. They will supply to future historians of science the most precious materials illustrating the development of HAMILTON's discoveries. They will exhibit, doubtless, germs of thought suggestive to others of new discoveries. They record a great *commercium epistolicum*—his correspondence with the most distinguished scientific men of his own age. Nay, more, they will be found to contain memoirs on a variety of subjects, complete in themselves, and carefully elaborated, but which he had abstained from publishing, either because they were unconnected with the greater works which he had in hand, or because he hoped to develope them more fully at some future time. It is to be hoped that they will yet see the light, and, like the posthumous memoirs of Euler, inspire us with a feeling that their great author is still holding converse with us. It will be a satisfaction to the members of this Academy to be told that his "Elements of Quaternions"—the work upon which he was engaged with the most unceasing activity for the last two years—is all but complete. I have reason to know that at no period of his life—not even when he was in the prime of health and youthful vigour—did he apply himself to his mathematical labours with more devoted diligence. Those who did not actually know how he was employed, or who had formed a false estimate of his character, might imagine him indolently reposing upon his laurels, or pursuing his studies in a desultory way. Such a conception of him would be the very opposite to the true one. His diligence of late was even excessive—interfering with his sleep, his meals, his exercise, his social enjoyments. It was, I believe, fatally injurious to his health.

Believe me, Gentlemen, the fame of SIR WILLIAM ROWAN HAMILTON, great as it was during his lifetime, will become yet greater when the world has been furnished with materials enabling it more perfectly to estimate the variety and richness of his endowments and the value of the services which he has rendered to Science. His reputation, even now, does not rest on the partiality of friends and countrymen. The learned men of all lands have already declared him worthy of the highest honours which can be paid to intellectual eminence. This world-wide recognition, at the present time, of his genius and discoveries, affords us a sure pledge and earnest of the perpetuity of his reputation, and warrants us in regarding his name as a glory which is not to pass away from the scientific and literary chaplet of Ireland. And in this fact and this anticipation we might thankfully and happily behold a full justification of his own early, and it might have been feared enthusiastic, aspirations—of his deep and generous consciousness that he was intrusted with faculties and powers capable of achieving in the noblest fields of thought a worthy fame both for himself and for his country. What were his feelings on this high subject of conscious power in connexion with fame his Sonnet on Shakspeare beautifully expresses; and I cannot better conclude my sincere but inadequate tribute to his memory than by repeating those moving and characteristic lines:—

"Who says that Shakspeare did not know his lot,
But deem'd that in time's manifold decay
His memory should die and pass away,
And that within the shrine of human thought
To him no altar should be reared? O hush!
O veil thyself awhile in solemn awe!
Nor dream that all man's mighty spirit-law
Thou know'st; how all the hidden fountains gush
Of the soul's silent prophesying power.
For as deep Love, 'mid all its wayward pain,
Cannot believe but it is loved again,
Even so, strong Genius, with its ample dower
Of a world-grasping love, from that deep feeling
Wins of its own wide sway the clear revealing."

I cannot doubt, Gentlemen, that I have had your sympathy in the expression of my respect and admiration for one who was your President—for one who, indeed, as a human being, had his share of human infirmity, but whose truly [illegible] greatness, both intellectual and moral, was such as every Irishman will long love to dwell upon.

It was resolved unanimously,—

That the Academy deeply deplore the loss sustained by them in the death of Sir Wm. Rowan Hamilton, and return to the President their hearty thanks for the eloquent and touching address delivered to them.

MONDAY, DECEMBER 11, 1865.

THE VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

Mr. W. H. Hardinge read a paper "On the Irish Transplantation of A. D. 1653–54; and on the Extent, Value, and Distribution of the Lands forfeited in Ireland."

Mr. W. HANDSEL GRIFFITHS read the following paper:—

ON HÆMODROMOMETERS.

THERE has long been a question among physiologists as to the velocity with which the blood moves in the arteries. Many of them have made calculations which, had they come from others than men of such repute, would have excited derision; and indeed we can scarcely refrain from smiling when we read that Hales "inferred the velocity of the blood at the commencement of the aorta in man to be at the rate of 735 feet per second."

The celebrated Volkman saw the folly of the deductions drawn from such vague data as these were, and he devised an instrument, which he termed the "Hæmodromometer," the object of which was to *measure* the velocity of the movement of the blood in the arteries.

The results of experiments made with this instrument were, of course, much more reliable than those founded on calculations inferred from data of the most vague and uncertain character; but, while I would unhesitatingly give the preference to the deductions drawn from experiments with Volkman's Hæmodromometer, I can by no means assent to the supposition that they are correct, *or even nearly so.* The use of Volkman's instrument involves great objections; and, although I look on the instrument itself as a model of ingenuity, I cannot regard it as one on which I should depend for a solution of the problem, With what velocity does the blood move in the arteries?

I will proceed to describe as briefly as possible the construction and mechanism of Volkman's Hæmodromometer. I will then consider the objections which I entertain to it; and it is but right that I should afterwards mention how I would propose to rectify these defects.

Volkman's Hæmodromometer consists essentially of a glass tube, which is bent into the form of a hairpin, and is fifty-two inches long. This tube is filled with water; and, by a peculiar arrangement, is placed between the open ends of a cut vessel. For a concise description of this instrument, I beg to refer to Todd and Bowman's "Physiological Anatomy," vol. ii., page 364. In the drawing which is given in that work is represented a tube, which is constructed of metal, and measures one inch and a half in length; it terminates at cones, which fit into other cones, by which means they are adapted to the cut ends of the vessel. The mechanism of the stopcock is indeed an admirable contrivance; and, although easily understood, is rather difficult of description. The handle commands the course of the tube by means of two cogged wheels, so that when it is turned in one direction it allows a free passage *directly* from one end to the other; and when it is turned in the opposite direction *this* free passage is interrupted, and another passage, namely, from one end, *along the hairpin tube*, to the other end is opened; so that at the will of the operator he can open one communication to the exclusion of the other, but he cannot obtain a double communication. The glass hairpin-shaped tube is attached to a board, on which is fixed a scale.

When the Hæmodromometer is used, a large artery is exposed for about three inches, and a piece is cut out of it after means have been adopted for the prevention of hemorrhage. The next step is to fix the cone-shaped open cups into the open ends of the artery, and each end of the horizontal metal tube is then fitted into its corresponding cup. I should mention a precaution which it is here necessary to observe—it is this: to so arrange the distance of the cups that, when the horizontal tube is introduced between them, the *continuation of the vessels* is as little altered as possible by the intervening mechanism. The blood now continues to circulate through the horizontal tube as it would were the vessel entire, the stopcock being so turned as to shut off communication with the glass tube. This latter is now filled with water, and is fixed to the horizontal tube by means of pipes. The arrangement is now complete, and the stopcock is turned, so as to shut off the *direct* communication between the two ends of the horizontal tube. The blood now enters the glass tube, and pushes the water before it into the peripheral blood vessels, with (according to Volkman) only a very slight admixture between the two fluids.

I have now described at length this very ingenious instrument; and it would seem at first that it supplies what is needful, in every respect, and that the results obtainable from experiments with it are very reliable. On mature consideration, however, no one will fail to perceive that there *are* grave objections to it; and it now devolves upon me to mention those which have struck me as being most prominent. There are one or two of these objections which I myself have not succeeded in obviating; and many will say that it were well that I should pass over these, and confine myself to such as I *can* remove. Were I to heed such suggestions, I should not be performing the duty I have taken on myself; for, although the instrument which I am about to describe I believe to have many advantages over that of my brother physiologist, no one is more sensible of the fact than I am that it is by no means a perfect instrument, and that it is itself open to great objections—objections which I do not despair of being able to remove at some future period, or which, I myself being incompetent, will I doubt not be done away with, and that right speedily, through the exertions of the learned physicists and physiologists to whose notice I submit them. Thus, in mentioning objections to Volkman's Hæmodromometer which baffle my own inventive faculties to remove, I anticipate the defects of my own instrument.

The first objection which I have to state to Volkman's Hæmodromometer is applicable to mine also—it is that of *the sudden propulsion of the blood from a tube of elastic and contractile force into one perfectly inelastic, and one not having muscular force.* The effect of this condition is more serious than is generally imagined; for when the natural calibre of the *artery*, or its caliber *when not in the distended state*, corresponds with that of the *glass tube*, the former is capable of receiving a greater quantity of blood than the latter; and the contractility called into action by this expansion is now exerted, and contributes to quicken the velocity of the remaining fluid. No such conditions as these exist in the glass tubing; and the only plan I have adopted, with a view to lessen this difference between the two tubes, is to use a glass tube whose caliber will be equal to that of the artery when at a moderate expansion.

The second objection is one which, although I have considerably lightened, I have not been able entirely to meet, namely, the *existence of sharp turns in the long glass index tube.* In Volkman's instrument there are three of these sharp turns; one at the entrance, and another at the exit, both of which are right-angled; the third is situated in the centre of the tube, and is in reality made up of two turns, each of which is right-angled also; the *effect* is alleviated in the latter case by the curves being well directed; but in the former cases, namely, at entrance and exit, the arrangement is directly angular. I need not say how detrimental to the velocity of a running fluid the presence of these angles is, nor need I explain how the column of blood which is being propelled into the tube, meeting at its entrance an opposing wall has to be reflected, as it were, from it before it pursues its course. The same takes place at the exit of the tube, except that here the reflection, if I may be allowed the term, takes place in an opposite direction; so that, instead of the fluid being prevented to a degree from entering the tube, it is here hindered in leaving it—not *altogether*, of course, but in a degree to affect considerably the velocity of the movement of the contained fluid. At the centre of the tube, also, is a sharp turn, arranged so that the fluid arriving by one limb of the tube has to be sent back immediately after moving round this sharp double turn in the opposite direction. My instrument must be regarded as of much better design in respect to *curves in the tube* than that of Volkman; for, while the fluid entering into his is immediately sent in a direction at right angles to the course, the direct course of mine is interrupted but very little. The curves in my Hæmodrometer are greatly exaggerated, and the caliber of the tube where they exist is slightly increased.

The third objection which I would urge is *the sudden propulsion of hot blood from a vessel of a certain temperature into another of a much lower degree of heat, or almost cold.* This defect would seem to be of such trivial consequence as to warrant its being entirely overlooked. The experiments which I have made touching this question, however, induce me to insist on the above as a decided objection. I have seen that when blood or any other fluid is heated to a certain point, and is passed through a vessel of a certain temperature, and when, after traversing this tube for a certain distance, it is then made to pass through another tube continuous with the first, but cooled to or below zero, the velocity of the running fluid is diminished from that which was maintained in the heated tube. The manner in which I have sought to remedy this evil is the following :—The flat support, to which is attached the essential part of the instrument, is made so as to contain two moveable iron heaters; when these are removed, and heated, and then sent home into their respective cavities, the warmth they contain is communicated first to the copper support, and thence to the glass tube, through which the blood courses.

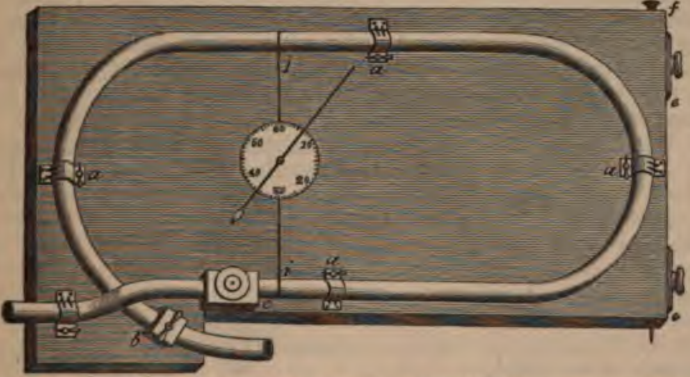
The next objection refers rather to the mode of using the Hæmodromometer than to the instrument itself. Volkman's apparatus was, you will remember, filled with *water* previously to operating. Now, no one will refuse to recognise the inadvisability of the blood having to meet a fluid of a very different specific gravity from itself, and one, moreover, whose total immobility it has to overcome ere it can itself move an inch. I look upon this as a most serious objection to Volkman's mode of estimating the velocity of movement of fluid in a tube; and indeed Volkman himself would seem to have anticipated that the validity of his method would be called into question on this account, since he takes care to inform us that the water is moved into the peripheral arteries with but little admixture with the blood. I can only say that I have put Volkman's statement to the test of *experiment*, the most reliable criterion, and I have invariably found the mixture of the two fluids to be most considerable, and the specific gravity of the resulting mixture to vary much from that of either the blood or water. When using my instrument, I apply one end of the tube to the cut end of the artery whence the blood flows, and I apply suction at the other end, so as to create a vacuum, into which the flood flows freely. When it has arrived at the opposite end, having turned the stopcock, I remove the ligature which had been placed on the peripheral end of the artery, and introduce the end of the tube into that of the vessel; and the blood flows, on again turning the stopcock, as though it experienced no interruption whatsoever. Of course, these latter operations should be performed as quickly as possible; and, in order to avoid the trouble of tying and untying ligatures, I make use of a minute forceps—one which on pressing with the fingers opens, and on removing the pressure closes with a tight grip.

I have now mentioned the four great objections which I have to Volkman's Hæmodromometer: each one of them *tends to decrease the velocity of the blood's movement; and hence, when we consider the combined effect of these, we must allow that the results of experiments made with this instrument are not such as can be relied upon, nor do they correctly estimate the velocity with which the blood moves in the arteries.*

It now behoves me to describe a Hæmodromometer which I would propose as a substitute for Volkman's; and I must confess that I feel considerable diffidence in so doing, not because I myself doubt for one instant the superiority of my instrument as far as regards accuracy, but since I feel it to be presumptuous in me to offer aught to the scientific world intended to compete with the productions of so learned a physicist and physiologist as Volkman. My duty, however, prompts me not to yield to such feelings; and so, with a firm conviction of its worth, I proceed to the description of my Hæmodromometer. In my description I beg to refer to the diagrams, such as they are, which I have drawn, in order to render the details more intelligible.

The complete instrument, as seen in the drawing (Fig. 1), consists of the copper support, to which is attached, by means of the fasteners (*a*, *a*, *a*), the glass index tube, furnished with its arrangements of stop-cock (*b*), and piston (*c*). The free extremities of the glass tube extend slightly beyond the support, so as to be more readily connected with the cut ends of the artery. Near the centre of the support is a chronometer, the hand of which describes the circle in one minute. At one side of the support are represented the heaters (*e*), which are sent home into their respective cavities.

Fig. 1.



The shape and construction of the support will be readily seen on glancing at the diagram. It is made of copper, which is a very good conductor of heat. At its side are the openings of the two cavities, which extend longitudinally along it for about three-fourths of its length; into these cavities run the iron heaters, furnished with handles of porcelain, so as not to burn the hands of the operator when they are to be removed from the fire. The heaters are kept in their position in the support by means of a long iron pin, which runs through a hole in the support and heaters, as seen in the drawing (*f*).

The index tube will be seen to have a peculiar form; and, simple as this form looks, it has cost me much thought and consideration to determine on it as being that which would be least likely to prove detrimental to the flow of fluid in it.

This tube will be observed to have no sudden angles in its course. The fluid on entering into it is *not* met by an opposing wall, as in Volkman's instrument, nor is it immediately turned in a direction at right angles to the one it was previously pursuing; on the contrary, the deviation from the natural course is gradual, and the fluid is coaxed, as it were, round the turns in the tube, when it arrives at them. I have already mentioned that the caliber of the tube equals that of the artery when at a moderate expansion, and also that the caliber of the turns of the tube is very slightly wider than the caliber of the straight portions. I need not again repeat why these differences in caliber should exist. From the foregoing remarks you have already anticipated the necessity for having different tubes, each with a different bore, so as to be applicable in the case of variously-sized arteries. I have described to you Volkman's arrangement of cone-shaped cups for connecting his tube to the ends of the arteries. I do not recognise the necessity for this plan at all; and I believe that, if the glass tube have its termination furnished with slightly raised edges, so as to take a purchase on the artery, the desired effect is obtained just as well.

The removal from or fastening of the different tubes to the support is easily effected by opening and shutting the fasteners (Fig. 1 *e*), which are furnished with hinges and clasps.

Fig. 2.

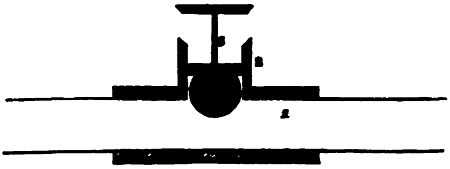
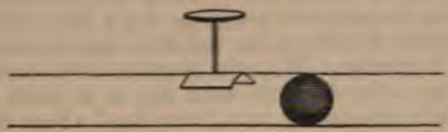


Fig. 3.

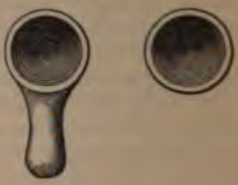
Each tube is furnished with a piston index apparatus (*c*), and with a stopcock (*b*). The piston index apparatus (Figs. 2 and 3), consists of two tubes, the one horizontal, whose bore equals that of the glass tube, and which is continuous with it; the other perpendicontinuous surface with the upper wall of the horizontal tube. In order to effect this continuity of surface, the press (Fig. 5) must be curved correspondingly to the wall of the horizontal tube; and it must be of such size as exactly to fit the piece which is wanting where the two tubes, horizontal and perpendicular, communicate. The whole of this mechanism is constructed of brass. The piston must be removable from its perpendicular square tube, so as to admit of the index ball, which I shall presently describe, being attached to its press. When an observation is to be made, the piston is to be taken out, together with the lid of the perpendicular square tube. To the under surface of the press is then attached lightly the index ball, which is made of gelatine. The arrangement is then placed in the position as seen in the drawing (Fig. 2), and the blood is now brought through the glass tube, the above preparations having been, of course, completed first. When the time has come for making the observation, after the blood has been circulating for a few seconds, the piston is pressed down, the spring which kept it raised is overcome, and another spring is engaged which keeps it down. The index ball is thus suddenly propelled into the current, and, being of a certain size, is carried along the tube with the same velocity as that with which the blood itself moves; the lower end of the press of the piston has at the same time formed the wanting part of the upper wall of the horizontal tube, and the blood courses without interruption. The index ball has not gone far before it comes up to a scratch (Fig. 1, *i*) on the glass index tube. As it passes this point, the operator glances at the chronometer, and notes the time; subsequently, the ball passes another scratch (Fig. 1, *j*), which is at a known distance from the former one, and immediately as it does so, the operator again consults the chronometer, notes the time, and turns the stopcock to prevent the ball from passing into the peripheral end of the artery. The observation is now completed, the index ball having passed through a certain distance in a certain lapse of time, and thus the velocity of the movement of the blood has been computed.

Fig. 5.



For a long time I was puzzled how to obtain balls of such lightness as would not affect the movement of the blood. After some consideration, I adopted the following process:—A warm concentrated watery solution of gelatine is made, and the polished extremity of an iron rod is rolled about in it, having been previously dipped in oil. The rolling having been continued for some seconds, the rod is taken out of the solution, and a thin coating of gelatine adheres to it. This coating has now to be removed from the mould, which is done by very gentle manipulation, until it is coaxed off. A small "exhauster," furnished with a sharp extremity, and with a stopcock, is now introduced into the open mouth of the gelatine ball, and, by working with the fingers, the latter becomes tightly applied to the extremity of the exhauster, and the air is sucked out from the ball by the mouth. When it is considered that nearly all the air has been subtracted, the stopcock is turned before taking the exhauster from the mouth, and while the suction is yet going on; a little careful manipulation is now required to remove the ball from the exhauster without allowing the air to re-enter. When the operator has succeeded thus far in the manufacture of his ball, the next step is to make it as round as possible. This is effected by two "rounders" (Figs. 6 and 7), which I have sketched; these consist of polished metal; they are hollowed out slightly from centre to surface; one of them is furnished with a handle, and the other is to be laid on the table when using them. They are first heated by pouring some warm oil on the polished hollowed surface; the index ball is put on the one which is stationary, and the other "rounder" is *gently* worked over it in a circular manner until the ball has become perfectly round; the rounders are heated at intervals by adding more hot oil to their polished surfaces. I need not mention the necessity there is for iron moulds of *different* bulk, in order to produce balls of different sizes, adapted to the variously sized tubes.

Figs. 6 and 7.



I have now completed the description of my Hæmodromometer. That I do not expect it to be considered as anything like a perfect instrument, I have already said. I know that some physiologists will object to it on account of the complexity of previous operations which must be performed when working with it; but will any one, I ask, give the preference to Volkman's instrument simply because of the trouble of working which mine would cost the operator? If so—if it is desirable that instruments be made with a view rather to save the operator work, than to attain to accuracy of result—then have I laboured in vain.

The following donations were presented:—

1. From the Society of Antiquaries of London the following publications of the Society:—
   "Layamon's Brut," edited by Sir F. Madden. 3 vols.
   "Rotuli Scaccarii Normanniæ," edited by T. Stapleton. 2 vols.
   "Codex Exoniensis," edited by B. Thorpe. 1 vol.
2. From Joseph Gurney Barclay, Esq., "Astronomical Observations, 1862-64."
3. From the Commendatore Negri Cristoforo, "La Storia Antica Restituita."

The thanks of the Academy were voted to the donors.

MONDAY, JANUARY 8, 1866.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The Rev. B. W. Adams, D. D.; Rev. Thomas D. F. Barry; George Hatchell, M. D.; Edward S. O'Grady, Esq.; Daniel O'Sullivan, Esq.; Joseph O'Kelly, A. M.; Henry Wilson, M. R. C. S. I.; and Rev. Richard Wrightson, B. A.; were elected members of the Academy.

Dr. E. Perceval Wright read a paper, the joint production of himself and Professor Huxley, "On the Fossil Remains of some large Batrachian Reptiles from the Irish Coal-measures." Part I.

MONDAY, JANUARY 22, 1866.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The President stated that in consequence of the lamented death of Dr. Petrie, and out of respect to his memory, no literary communications would be made this evening.

The Academy accordingly adjourned.

MONDAY, FEBRUARY 12, 1866.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The PRESIDENT delivered the following ADDRESS on the loss sustained by Archæological Science in the Death of GEORGE PETRIE, LL. D.:—

ADDRESS.

GENTLEMEN,—Only a few weeks have passed since I was called on to express our sense of the loss sustained by the Academy—by Science itself—in the death of Sir William Rowan Hamilton. If any one of us had been asked, a year ago, to enumerate the great men of our own country and our own time, he would have been almost sure to give precedence to the name of Hamilton. And now, whilst our mourning for him is recent, before we have accustomed ourselves to the thought that he is no longer a fellow-labourer with us, that he has gone to his rest, and that the works which he has left unfinished must be carried on by other hands, death has made a fresh inroad on our ranks, and robbed us of all the pleasure and the pride which we felt in companionship with one who, in the department of antiquarian and historic literature, had attained a pre-eminence as decided as that which Hamilton had won for himself in the pursuits of mathematical science. It is hardly possible to exaggerate the gloom which the death of GEORGE PETRIE has cast over the friends of literature in Ireland; for his name had become a household word amongst us. His genius and learning had rendered him famous; and the charm of his noble and graceful character had made him equally beloved. Thus he had grown to be a power—the centre of a great sphere of intellectual activity; and we could not conceal from ourselves the obvious fact, that his removal from the field of his labour is a source of peculiarly anxious concern.

The death of a great mathematician like Hamilton is with reason lamented, because it certainly retards the development of those branches of mathematics in the cultivation of which he had been most successful; but it can hardly be thought of as absolutely irreparable to science. The band of whom one of the leaders has fallen is a numerous one. It gathers its recruits from all parts of the civilized world. It extends its conquests with a march certain, though not uniform, into the regions of the unknown. Scientific progress in any particular direction suggests research, and facilitates further progress. Thus science advances like a tide, pressing onward with an accumulating force. If Newton and Leibnitz had died before they had made their famous discoveries, we can hardly doubt but that other scholars in these kingdoms, in France, in Italy, in Germany, or in Russia, would have created the Differential Calculus, and furnished us with an instrument, the need of which was felt in dealing with most of the great problems which at that period engaged the attention of mathematicians. The successful prosecution of the studies to which PETRIE devoted his life depends on circumstances of a more precarious nature; and we cannot count with the same certainty upon their continuous progress. We cannot expect that many will apply themselves to the history and antiquities of Ireland; and of those who do, how few are likely to illustrate them by the critical sagacity, the extensive learning, and the sound judgment of the veteran scholar whose loss we are now lamenting! Let any man picture to himself the condition to which Irish archæology and other kindred studies would have been reduced, if it had not been for the labours and the influence of PETRIE during the latter half of his life; he will then understand why PETRIE's death has been felt as a national calamity.

GEORGE PETRIE was born in Dublin, on the 1st of January, 1790. He was the son of James Petrie, an eminent portrait and miniature painter, from whom he inherited a taste for both literature and art. His general education was carefully attended to. He was sent to the school of Mr. Whyte, of Grafton-street, who at that time gave instruction to the sons of many of the most distinguished citizens of Dublin; and there, sitting perhaps at the same desk as that at which Thomas Moore and Richard Brinsley Sheridan had sat before him, he acquired that sound knowledge of the English and of the Classical languages which he afterwards turned to good account, when he became a man of letters. As a boy, he showed a decided preference for art. At an early age he was allowed to assist his father in painting miniatures; and when only fifteen had attained such skill in drawing as to gain a silver medal for a group of figures in the School of the Dublin Society. Occupations of this kind being more to his taste than the studies and associations connected with the profession of surgery, for which his father designed him, he was permitted to follow the bent of his genius, and for several years devoted himself to landscape painting.

This is not the occasion on which a full account of his labours as an artist would be appropriate; but I may be allowed to say, that they were varied and successful. His pencil was for many years put in requisition by those who sought for the most perfect illustrations of Irish scenery and topography. His drawings were engraved by the most celebrated engravers. The pictures exhibited by him in London and in this city attracted the admiration of the most accomplished art critics. I have some idea of the causes of his success. I believe that it was due, in the first instance, to the truthfulness with which he represented the grace and harmony of the lines traced by Nature herself in the real landscape. He seems to have perfectly appreciated their characteristics. He knew that these lines are produced by natural agencies of various kinds working simultaneously—by forces which shape the outline of a mountain, as well as by those which determine the form of a leaf. It was his nice perception—or call it, if you will, an intuitive feeling—of the proper flow of each separate line, and of its relations to the other lines in the picture, which enabled him to produce drawings almost matchless in delicacy and grace. If I have failed to convey my meaning to any of my hearers, I can promise them that they will at once recognise the excellence of which I have been speaking in the illustrations contributed by PETRIE to Lord Ormond's "Autumn in Sicily." His skill as a draughtsman was transcendent. Critics allege that as a colourist he was less successful. It is not given to the same man to excel in every branch of his art. Still it must be said of him that he showed a fine perception of harmony and balance of colour, even though we may admit that he was sometimes deficient in force. But the artist who could paint such pictures as his "Pass of Llanberis," his "Walk in Connemara," his "Shruel Bridge," and "The Home of the Herons," has secured for himself a high place in the list of water colour painters. These are works in which the artistic treatment of the subject manifests an intense love of Nature, and a familiar acquaintance with the expressions of her ever-changing face. And they possess a higher merit. They are not the products of a merely imitative art. They are poetical in their conception, and full of imaginative power. Praise from one who has so little practical acquaintance with art as I can lay claim to may be nearly valueless; but I believe that, even in the presence of those who have most knowledge on this subject, I should provoke no expression of dissent, if I asserted that PETRIE had attained to a very distinguished position as a painter. His brother artists in this country long ago acknowledged his eminence by conferring upon him the honourable office of President of their National Academy; and artists of the highest repute in England, by their correspondence and their friendship, bore testimony to the respect which they entertained for him as a professional compeer.

From his schoolboy days PETRIE took an interest in the monumental remains which fell under his observation in the neighbourhood of

Petrie contributed numerous papers to our "Transactions" and "Proceedings." His first communication was a paper "On the Autograph Original of the Annals of the Four Masters." This was followed by a description of the Domnach Airgid—an ancient reliquary, containing a copy of the Gospels, which belonged to St. Patrick. I must refrain from stating the titles of his other contributions, with the exception of the three to which this Academy awarded its gold medal. These were—his essay "On the Origin and Uses of the Round Towers;" his essay "On Military Architecture in Ireland;" and his essay "On Tara Hill." The second in order of these essays remains unpublished. I proceed to notice the contents of the other two.

The work which is most closely associated with the name of Petrie is his celebrated "Essay on the Round Towers." It was originally written for and presented to the Academy, and was rewarded by your gold medal, and a prize of £50, in 1833. This essay is included in the treatise "On the Ecclesiasiastical Architecture of Ireland," of which the first portion forms the twentieth volume of our "Transactions." The writer, feeling that the question as to the origin and uses of the towers could not be satisfactorily settled except in connexion with a systematic review of Christian architecture as it existed in Ireland previous to the Norman invasion, wisely resolved to make his essay the basis on which to erect a more comprehensive work; and that work, intended to be exhaustive and decisive on the subject of which it treats, grew under his hand into proportions very different from those of the original design. References had to be made to authorities of different times and in different languages—many of the most conclusive being gathered from our Irish MSS., and produced by him for the first time; although it might have seemed natural that writers, treating of Irish antiquities, would have looked, in the first instance, to our own history and annals for information. In order to furnish adequate means of judging of the structural features of the buildings described, it was also necessary to supply abundant illustrations. In preparing these, the author was independent of the assistance of other draughtsmen. The volume is enriched by numerous drawings, which are almost as interesting to the artist as to the antiquary. Again, our fellow-Academician conceived it to be necessary to examine and confute all the opposing theories as to the origin and uses of the towers. This imposed upon him the obligation of showing, as regards their origin, that they were not Danish or Phœnician; and, as respects their uses, that they were not fire temples; that they were not places from which the Druidical festivals were proclaimed; that they were not astronomical observatories; that they were not phallic emblems, or Buddhist temples; and, lastly, to come to supposed Christian uses, that they were not anchorite towers, or penitential prisons. To prove a single negative is proverbially difficult. Can we complain, then, of Petrie as having been tedious, if, in the compass of about one hundred and twenty pages, he has temperately and conclusively disposed of so many erroneous theories? I make bold to say, that he has disposed of them, though there yet remains, and had them placed for security in an unoccupied glasscase in the board room. These antiquities, as I have heard from his own lips, had previously been left exposed for years on the floor of a small apartment, called a Library, in the upper storey of the Academy House; and between the period when PETRIE had first seen them in this situation, previously to his election as member of the Academy, and that at which he rescued them from future danger, nearly one half of the articles, and those the most precious, had disappeared. From this epoch dates a period of fruitful activity in our Committee of Antiquities, happily contrasting with the inertness of the previous seventeen years, during which its meetings had been absolutely suspended. I should occupy too much of your time, if I attempted fully to record the services which PETRIE rendered to the Academy, by helping towards the acquisition of the various collections, the assemblage of which in our Museum has given it a national character. It must suffice for me to name the Underwood Collection, and those of Dean Dawson, and Major Sirr. It is right to notice that in these various movements PETRIE received the most cordial and efficient support from the late Professor Mac Cullagh, whose sympathies were, no doubt, drawn forth by the manifestation on PETRIE's part of a truly scientific spirit in his method of dealing with antiquities. Many of you are aware that it was at PETRIE's instance that Mac Cullagh purchased the Cross of Cong, and made that splendid donation to our Museum; and I may add his generous contribution towards the purchase of the Tara Torques as another proof of the same sympathy. Indeed, it may be recorded as one of PETRIE's academical distinctions, that to his personal influence was mainly owing that happy union between the scientific and archæological elements within our body, upon which we may now congratulate ourselves, but to which, before his time, corresponded a relation of passive, if not active, opposition.

PETRIE contributed no less important services towards the formation of our Library. Whenever opportunities offered of acquiring Irish MSS., he exerted his influence to induce the Academy to supply funds for their purchase. The grant placed at his disposal for this purpose being frequently inadequate, he ventured more than once, at his own risk, to secure MSS. the value of which he understood better than any one, and which he knew ought to be added to the Academy's collection. Thus, at the sale of Edward O'Reilly's MSS., after the Academy's grant of £50 had been exhausted, he purchased for himself some of The O'Cleary's MSS., and afterwards gave them up to the Academy at the cost price. Having become under precisely similar circumstances the possessor of the autograph copy of the second part of the "Annals of the Four Masters," he generously surrendered it to the Academy for the sum he had given for it, although immediately on its becoming known in the saleroom what the MS. was, he was offered, in the first instance, £100 over and above the purchase money, and was subsequently pressed to name any sum that would induce him to resign it. In acknowledgment of the generosity and zeal evinced on this occasion by PETRIE, the Academy passed a resolution declaring him a Member for Life.

Such, for instance, is the account of the compilation and promulgation of laws by Cormac Mac Art, in the middle of the third century; and the compilation, two hundred years later, of the "Seanchus Mor," in the time and at the instance of St. Patrick. The hints which he has given in this paper will afford valuable help towards the settlement of some of the most perplexing questions connected with our early Irish history Though we may feel sure that the catalogue of 142 kings who are recorded as having reigned at Tara prior to its desertion in the year 565 is largely mythical, we should be rash in totally rejecting all the statements for which we have no better authority than bardic legends. PETRIE has pointed out the probability of some of these, and adduced confirmations of them, derived from independent and trustworthy sources. One of the most curious parts of the "Essay on Tara" is that in which he discusses the perplexing difficulties which beset the history of St. Patrick—I might rather say, of the Saints Patrick, for there were certainly two of the name—and proposes to identify the second St. Patrick with Palladius. The recent investigation of this subject by Dr. Todd has brought its difficulties into a clearer light; but the solution of them seems still almost beyond our reach. The second portion of the essay furnishes a striking instance of the use to be made of antiquarian research in establishing the authenticity of documents. The "Dinn Seanchus," a well-known topographical work of great antiquity, contains tracts and poems relating to Tara, some of which describe with considerable minuteness the buildings which formerly stood there. With the buildings so described PETRIE was able with complete certainty to identify the crumbling remains which are still apparent. Such a confirmation of the accuracy of the accounts disposes us to attach more credence than we should otherwise have given to statements respecting the uses to which the various structures were applied, and all the details respecting the mode of life of their ancient occupants. The truth of these very ancient testimonies being corroborated in certain points, the probability of their being in the main trustworthy is increased in a high degree.

The circumstance which must be considered the most important in PETRIE's life as giving definiteness to his labours and completely developing his powers, was his connexion, in the year 1833, with the Ordnance Survey of Ireland. The occasion for his services in this department arose in the following manner:—In the construction of the maps, it was a matter of primary necessity to determine the orthography of the names of places; but it also proved to be a matter of extreme difficulty. Various modes of spelling them were found to be sanctioned by common usage. Reference, therefore, had to be made to documents of all kinds; and an inquiry, involving comparison between the existing and the ancient states of the country, had to be instituted; in fact, questions relating to the spelling of the name of a townland or a parish frequently gave rise to elaborate researches, which were not disposed of till it had been ascertained that the name was indicative of some early sept, some ecclesiastical establishment, or ancient chief. Thus the co-operation of the historian, the antiquary, and the philologist, was found to be essential. Under the direction of Lieutenant (now Sir Thomas) Larcom, who conceived the idea of drawing together every species of local information relating to Ireland, and embodying it in a Memoir accompanying the Ordnance Survey Maps, PETRIE was employed to take charge of the topographical department, to collect all the materials, and superintend the persons engaged in that part of the work. There, as the head of a literary staff, he had the assistance of several persons who possessed a good knowledge of the Irish language, and to whom he communicated his own methods of systematic inquiry, and the refinement of a more extended scholarship. It was from PETRIE that John O'Donovan and Eguene Curry received the training which enabled them afterwards to contribute in so many ways to that great development of ancient Irish literature which we have witnessed in the last quarter of a century. He became the informing spirit, the great instructor, of a school of Archæology. He not only laid down the principles, but exemplified upon a great scale the application to antiquarian science of the principles of a philosophic induction. Before his time, Irish antiquaries had brought discredit upon their pursuits by the variety of errors into which they fell. Some followed blindly in the wake of those who had gone before them, subjecting their conclusions to no examination, neglecting to gather and sift original documentary evidence, and hardly looking at the very objects of which they professed to give accounts. Others framed fanciful hypotheses, and then spent all their labour in casting about for arguments by which their theories might be supported. I need not go beyond the names of Vallancey and Beaufort for examples of the erroneous methods to which I have alluded; and it is deeply to be lamented that the influence of their school is still felt amongst us; and that with a very large number of persons it seems to be a point of honour, or almost a matter of faith, to maintain theories in which the parts really played by our Celtic progenitors are assigned to Etruscans, Phœnicians, and races inhabiting regions still more remote. Against such misleading tendencies PETRIE had to struggle, and he has combated them with a success which will be more fully recognised as the nature of his work comes to be better understood. He first showed how to make the contents of our ancient Irish MSS. available for the purposes of antiquarian research. He had large collections made from them of passages bearing upon questions of topography, history, architecture, and so forth. And he took pains to satisfy himself that the true meaning of these was furnished by scholars having a competent knowledge of the Irish language. He explored almost every part of Ireland himself, filling his sketch books with careful drawings of ancient remains; and it was by means of a comparison of these with one another, and with the notices of them contained in ancient documents, that he established general and solid conclusions respecting their nature. The results of this process, especially those having a philological bearing, as exhibited in the "Ordnance Survey Memoir," called forth the expression of Pictet's cordial recognition of the importance of his work, and of the merit of its execution. It is true that the literary and ecclesiastical history of Ireland had received important elucidations from the labours of Archbishop Ussher, Sir James Ware, and Colgan; but before PETRIE's time little had been done to illustrate our topography, our prehistoric monuments, our military and ecclesiastical architecture. Sir James Ware had treated but superficially of these classes of antiquities. His assertion that the Irish had no knowledge of the art of building with stone and lime till the time of Henry II. proves how limited was his knowledge of this subject. He had hardly any acquaintance either with the actual remains, or with the Irish language, and was therefore unable to connect the antiquities with a history existing only in MSS. Towards the close of his life he employed an Irish translator, but not till the greater part of his antiquarian collection had been completed.

The contributions of PETRIE to antiquarian knowledge were not confined to the "Transactions" of this Academy and to the "Memoir of the Ordnance Survey." To touch more cursorily than they deserve on Guide Books, which in the earlier years of his life were indebted both to his pen and his pencil, the "Dublin" and the "Irish Penny Journal" contain a large amount of matter of great interest illustrative of the picturesque ruins and the relics of art with which his rambles through Ireland had made him acquainted. As the woodcuts of these cheap publications show the true artist's hand, so does the letterpress furnish numerous descriptions marked by all his characteristic accuracy and good taste. These volumes have thus acquired a permanent value.

His rambles through all parts of Ireland called into exercise another of his natural gifts, which, like the rest, he made to contribute to the perpetuation of his country's peculiar endowments. I refer to his musical faculty. This, which was of a high order, enabled him to catch the native melodies which he heard from all manner of persons, and in as varying circumstances, and to commit them to his notebook. Part of the fruit of this loving care is to be seen in a volume published by the Irish-Music Society, in which about one hundred and fifty airs, thus rescued by him, are carefully arranged, and introduced by notices of their history, gracefully written, and full of interesting illustration of Irish character and social life. He had previously contributed many airs to the collections of Holden and Bunting; and several hundred more, I am told, are still in his portfolios.

Among his unpublished antiquarian works are the following:—"An Essay on Military Architecture," "An Essay on Irish Bells," "A Description of Arran," "A History of Clonmacnoise," "A Description of the Sepulchral Monuments at Carrowmore," his Letters in the Ordnance Survey Correspondence, and his great Collection of Inscriptions.

After indicating, even in the summary way in which I have done, the extent and the nature of PETRIE's literary and artistic labours, it might seem almost superfluous for me to notice a charge which was sometimes brought against him in his lifetime. He has been accused of dilatoriness in his studies, and a want of systematic diligence in the prosecution of them. Of what scholar might not this be said? And who has used his time as profitably as possible? Petrie may not have been blameless in this regard; but I think that valid excuses may be offered in mitigation of the censure which has fallen upon him. In the first place, his health was always delicate, and his temperament sensitive. Thus, his total working power was less than that of many other literary men. His intense intellectual energy was out of proportion with his physical strength. And, besides all this, he was intentionally slow in his work, whether with the pencil or the pen, because he was cautious and truthful, and in the highest degree fastidious. He was unsparing of his labour, and indifferent about reward. Petrie united qualities which are seldom possessed by the same individual; he had the enthusiasm and the imaginative power which are essential to the artist; he also possessed the sagacity and calmness of judgment which are commonly supposed to be characteristic of the man of science. There was in him a singular gracefulness, combined with masculine force. He was sensitive, without being morbid; he was playful, but never wayward; he was candid in criticism, but never gave a gratuitous wound to the feelings of an opponent. "He exerted," as has been well said, "an influence which prompted and encouraged many minds in liberal ideas—in genial and tolerant social views—in the elegancies of native accomplishments, and in that appreciation of the generous and noble traits of the national character which is the true cement of society. Moreover, he largely helped towards achieving the great problem of our day—the reconciliation of the cultivated intelligence and loyalty with the popular aspirations and sympathies of the country."

Gentlemen, I need not try to complete this imperfect portrait of Petrie—the antiquary, the historian, the painter, the musician, the genial, refined, true-hearted gentleman. Your recollection will supply the traits which I have omitted, or drawn with a faltering hand. There is no reason to fear lest his memory should fade from amongst us. You will cherish every reminiscence of a man for whom you felt so warm an affection, and so profound a respect. His death has been a grievous loss to us. But we must not suffer our sorrow for the man to degenerate into a despondency injurious to the interests of those studies which were dear to him, and of which he was the ornament. He is indeed lost to our sight, and removed from our converse; much of the learning which he had amassed by laborious thought and patient study has perished with him, and the tooth of Time is silently but surely corroding the objects upon which he toiled. But let us find a consolation in the thought that his influence will survive in this Academy, and wherever there is a natural and healthful interest in the literature of Ireland. He will leave behind him disciples imbued with his spirit, and inheriting his methods of research; and I make bold to predict that great works, illustrating the history, the laws, the art, the language of this country, projected in his time, and promoted by his efforts, will hereafter be the monuments attesting the magnitude of the services which Petrie has rendered to the cause of our national literature. Petrie's genius did not spring up, like Hamilton's, with a sudden growth, and clothe itself with a preternatural show of flower and fruitage; but his reputation has been a growing one, and it will be a lasting one, because he also has done things which will endure.

"Crescit occulto velut arbor ævo Fama."

It has struck its roots deep in the affection and respect of Irish hearts; and it will continue to flourish there, unless we fall upon those evil days in which men lose all right to have hope from the living, because they have become careless and cold in paying honour to their illustrious dead.

The ballot for the election of a Member of Council to serve on the Committee of Antiquities having been scrutinized in the face of the Academy, the President reported that Lord Talbot de Malahide was duly elected to the place vacant on the Council.

The Secretary presented, on the part of the Rev. Robert King, a copy of the "Essay on the Primacy of Armagh" in the form in which it originally appeared as a portion of the "Armagh Guardian" newspaper.

MONDAY, FEBRUARY 26, 1866.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, read the following paper:—

ON THE METEORIC STONE THAT FELL AT DUNDRUM, COUNTY OF TIPPERARY, ON THE 12TH AUGUST, 1865.

THE Meteoric Stone, that forms the subject of the present Paper, fell near Dundrum, county of Tipperary, under circumstances that were described to me as follows, by the man in whose garden it fell:—

STATEMENT OF EYEWITNESS.

"I, John Johnson, of the parish of Clonoulty, near Cashel, county Tipperary, was walking across my potato garden, at the back of my house, in company with Michael Fahy and William Furlong, on the 12th of August, 1865, at seven P. M., when I heard a clap, like the shot out of a cannon, very quick, and not like thunder; this was followed by a buzzing noise, which continued for about a quarter of an hour, when it came over our heads; and on looking up, we saw an object falling down in a slanting direction. We were frightened at its speed, which was so great that we could scarcely notice it; but after it fell, we proceeded to look for it, and found it at a distance of forty yards, half buried in the ground, where it had struck the top of a potato drill. We were some time in looking for it (a longer time than that during which we had heard the noise). On taking up the stone, we found it warm, milk warm, but not hot enough to be inconvenient. The next day it was given up to Lord Hawarden.

"JOHN JOHNSON."

It was afterwards presented by Lord Hawarden to the Geological Museum of Trinity College, where it is publicly exhibited.

The stone weighed 4lbs. 14½ oz. It is rudely pyramidal in form; the triangular base being a freshly broken surface, and the faces of the pyramid being covered by the usual black vitrified glaze. It is evidently a portion of a much larger stone; and as it appears from the foregoing statement that its vertical velocity was not great, it is probable that other pieces of the larger mass may yet be found in the neighbourhood of Dundrum.

A singular feature is observable in this stone that I have never yet seen in any other:—the rounded edges of the pyramid are sharply marked by lines on the black crust, as perfect as if made by a ruler. This appearance is strictly confined to the surface, and seems to be a result of some peculiar tension of the fused crust in cooling; for no trace of any continuation of the lines can be found in the interior of the stone.

On examination with the lens, specks of metallic iron and of magnetic pyrites are visible, and also a few minute grains of chrysolith; no other minerals can be detected in the paste, which is of a dull grey, and of loose texture, almost like a porous sandstone; and the whole stone would attract little notice, were it not for its specific gravity, and the metallic particles visible in it. The specific gravity of this Meteoric Stone, as is usually found to be the case, varied in specimens taken from different parts of the mass. The portion analyzed was found to have the following specific gravity:—

	Grs.
Weight in air, ...	299·6
Weight in water, ...	201·9
Difference, . .	97·7 grs.

from which data the specific gravity is found to be,

$$\text{Specific gravity} = \frac{2996}{977} = 3 \cdot 066.$$

Other portions of the stone gave a specific gravity of 3·57.

From 100 grs. acted on with iodine,* which dissolved out the alloy of iron and nickel, there were obtained, of peroxide of iron, 27·95 grs., and of protoxide of nickel, 1·20.

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* This method of investigation was suggested by Mr. William Early, Assistant in the Laboratory of Trinity College; the process consists in digesting the powdered mineral in iodine with water for twelve hours, and proved to be completely successful, as was shown by comparative trials on different portions of the powdered mineral.

The portion insoluble in iodine was now acted on with dilute muriatic acid, and gave the following results:—

	Grs.	
Silica,	12·92	
Alumina,	0·15	
Peroxide of iron,	9·87	present originally as protoxide and protosulphuret of iron.
Carbonate of lime,	0·50	
Pyrophosphate of magnesia,	38·00	
Potash and soda chlorides,	0·45	
Platino-chloride of potassium,	0·42	
Oxide of manganese (Mn_3O_4),	0·05	

On treating another 100 grs. of the stone for sulphur, with muriatic acid, and conducting the sulphuretted hydrogen into ammoniacal solution of sulphate of copper, so as to form a black precipitate of sulphuret of copper, there were found by the usual methods 10·7 grs. of sulphate of barytes.

There were left, after the treatment with iodine and dilute muriatic acid, 42·1 grs. of mineral, insoluble in these reagents.

From the solution by iodine, and the determination of sulphur, as sulphate of barytes, we obtain—

	Grs.	Grs.
Peroxide of iron,	27·95	19·57 iron.
Protoxide of nickel,	1·20	0·94 nickel.
Sulphate of barytes,	10·70	4·05 protosulphuret of iron.

Hence we obtain, as our primary analysis of the Dundrum Meteoric Stone—

I.—*Primary Analysis of Meteorite* (A.).

1. Metallic iron,	19·57
2. Metallic nickel,	0·94
3. Magnetic pyrites,	4·05
4. Mineral soluble in dilute muriatic acid,	33·34
5. Mineral insoluble,	42·10
	100·00

The analysis of the earthy mineral soluble in dilute muriatic acid gives us (considering that 4·05 of FeS is equivalent to 3·68 of Fe_2O_3) the following result.

II. *Soluble Mineral* (A).

	Grs.	Per Cent.	Oxygen.
1. Silica,	12·92	38·74	20·112
2. Alumina,	0·15	0·45	0·209
3. Protoxide of iron,	5·51	16·55	3·671
4. Protoxide of manganese,	0·05	0·15	0·033
5. Lime,	0·28	0·84	0·340
6. Magnesia,	13·65	40·93	16·358
7. Potash,	0·08	0·24	0·039
8. Soda,	0·17	0·51	0·130
9. Loss,	0·53	1·59	
	33·34	100·00	40·892

Adding together the oxygen of the protoxides, we find—

$$\begin{array}{l} RO = 20{\cdot}571 \\ \left.\begin{array}{l} SiO_3 = 20{\cdot}112 \\ Al_2O_3 = 0{\cdot}209 \end{array}\right\} = 20{\cdot}321 \end{array}$$

This result identifies the soluble mineral with Chrysolith (or Olivine), unless it be supposed to be a mixture of several minerals. Neglecting all the lesser constituents, we have

	Oxygen.	
SiO_3, . .	20·1	
FeO, . .	3·671	20·039
MgO, . .	16·358	

which gives very well the formula of Chrysolith,

$$3RO, SiO_3.$$

The preceding analysis of the soluble portion of the Meteorite was checked by the following proceeding:—The 100 grs., from which the sulphur was determined, having been acted on by the muriatic acid, the acid solution was evaporated to dryness, and filtered; and the portion left on the filter was boiled with solution of carbonate of soda, so as to redissolve the silica soluble in muriatic acid. There were left 42·44 grs. of insoluble mineral, while the soluble portion gave

	Grs.	
Silica, ...	12·36	
Peroxide of iron, ...	38·60	Present originally as iron, protoxide of iron, and protosulphuret of iron.
Oxide of nickel, ...	1·44	
Carbonate of lime, ...	0·40	
Pyrophosphate of magnesia, .	32·62	
Potash and soda chlorides, .	0·40	

Assuming the iron (metallic) as 19·57, and the protosulphuret of iron as 4·05, we find

Equivalent of 19·57 Fe, ...	27·94 Fe_2O_3
„ 4·05 FeS, ...	3·68 „ „
	31·62

Subtracting this result from the total peroxide of iron, and converting the oxide of nickel into nickel, we obtain

I. *Primary Analysis of Meteorite* (B).

1. Metallic iron, ...	19·57
2. Metallic nickel, ...	1·13
3. Magnetic pyrites, ...	4·05
4. Mineral soluble, ...	32·81
5. Mineral insoluble, ...	42·44
	100·00

II. *Soluble Mineral* (B).

	Grs.		Oxygen.	
1. Silica,	12·36	38·86	20·175	
2. Protoxide of iron,	6·28	19·74	4·379	
3. Lime,	0·23	0·72	0·204	
4. Magnesia,	11 72	36·85	14·727	= 19·465
5. Potash,	0·07	0·22	0·036	
6. Soda,	0·15	0·47	0·119	
7. Loss,	1 00	3·14		
	31·81 grs.	100·00		

This result completely verifies that already found, and proves the soluble mineral of the Meteorite to be Chrysolith, having the formula

$$3RO, SiO_3,$$

in which RO denotes protoxide of iron and magnesia.

The 42·10 grs. of mineral insoluble in muriatic acid were divided into equal parts, of which one was fluxed with carbonate of soda, and the other with lime and chloride of ammonium, with the following results:—

	Grs.
Silica,	12·45
Alumina,	0·35
Peroxide of iron,	1·64
Oxide of manganese (Mn_3O_4),	0·16
Peroxide of chrome (Cr_2O_3),	0·51
Carbonate of lime,	1·45
Pyrophosphate of magnesia,	12·45
Potash and soda chlorides,	0·80
Platino-chloride of potassium,	0·90

Assuming the chromium to be present as chrome-iron, and making the necessary reductions in the other elements, we find

	Grs.
Original weight,	21·05
Chrome-iron,	0·75
Insoluble mineral,	20·30 grs.

III. *Insoluble Mineral.*

	Grs.		Oxygen.	
Silica,	12·45	61·33	31·842	
Alumina,	0·35	1·72	0·803	
Protoxide of iron,	1·23	6·06	1·344	
Protoxide of manganese,	0·16	0·78	0·174	
Lime,	0·81	3·99	1·133	11·943
Magnesia,	4·47	22·02	8·800	
Soda,	0·28	1·38	0·352	
Potash,	0·17	0 83	0·140	
Loss,	0·38	1·89		
	20·30 grs.	100·00		

It is not possible to form any opinion as to the mineral composition of the insoluble portion of the Meteorite, as it is doubtless composed of more than one unknown mineral substance.

If we collect into one view the preceding results, taking a mean of all, we obtain the following mineralogical composition for the Dundrum Meteorite :—

IV. *Mineralogical Composition of Dundrum Meteorite.*

1. Nickel-iron, ...	20·60	Iron, . .	19·57
		Nickel, .	1·03
2. Protosulphuret of iron, ...	4·05		
3. Chrome-iron, ...	1·50		
4. Mineral soluble in muriatic acid, probably chrysolith,	33·08		
5. Minerals insoluble in muriatic acid, ...	40·77		
	100·00		

ON THE SHOWER OF AËROLITHS THAT FELL AT KILLETER, COUNTY OF TYRONE, ON THE 29TH OF APRIL, 1844.

On the 29th of April, 1844, a shower of Meteoric Stones fell, in the sight of several people, at Killeter, near Castlederg, county of Tyrone: they broke into small fragments by the fall, one piece only being found entire; it was (according to the testimony of a resident) "about as large as a joint of a little finger." The stones were hot when found. The account given by three gentlemen, who, however, did not actually see the shower fall, was that they were at a distance of three or four miles, up the hills in the neighbourhood; it was a fine sunny afternoon (three or four o'clock); they heard "music" towards Killeter, which they supposed to proceed from a strolling German band which they knew to be in the neighbourhood; they are under the impression that they heard the music several times in the course of the evening; they remember also to have noticed clouds in the direction of Killeter. On reaching Killeter, the same evening, they were told of the wonderful shower of stones which had spread over several fields. I received the fragments of these stones from the Rev. Dr. M'Ivor, Ex-Fellow of Trinity College, Dublin, and Rector of Ardstraw: he writes to me that "it is now very difficult to get either a specimen of a stone, or any very distinct intelligence of them: even the very rumour of them has nearly died out, and you might ask intelligent middle-aged men about the neighbourhood who had never heard them mentioned." He adds that the people of that locality are very "uncurious," and that if there were a veritable burning bush thereabouts, few would "turn aside to see."

The largest specimen given to me by Dr. M'Ivor weighed 22·23 grs. in air, and 16·32 grs. in water, showing that its specific gravity is 3·761. Both it and the smaller fragments presented the usual black crust and internal greyish-white crystalline structure and appearance, with specks of metallic lustre, occasioned by the iron and nickel alloy that was present. I analyzed it in the usual manner; but, owing to an accident, I was unable to determine the composition of the earthy portion soluble in muriatic acid.

The following is the mineralogical composition of these Aëroliths:—

1. Hornblendic mineral (insoluble in acid), . .	34·18
2. Earthy mineral (soluble in acid), ...	30·42
3. Iron, ...	25·14
4. Nickel, ...	1·42
5. Sesquioxide of chrome, ...	2·70
6. Cobalt, ...	trace
7. Magnetic pyrites, ...	6·14
	100·00

The earthy portion, insoluble in muriatic acid, had the following composition:—

		Atoms.	
Silica, . . .	55·01 . .	1·22	
Alumina, . .	5·35 . .	0·10	
Protoxide of iron,	12·18 . .	0·34	1·66
Lime, . . .	3·41 . .	0·12	
Magnesia, . .	24 03 . .	1·20	
	99·98		

Omitting the alumina, the preceding analysis gives the rational formula of the hornblende family,

$$4\,RO,\ 3\,SiO^3,$$

and, taken as a whole, it agrees with the analysis of many hornblendes. The variety of hornblende with which it has the closest relation is anthophyllite.

According to Mr. Gregg's "Catalogue of Meteoric Stones and Irons," three other falls of Aëroliths are recorded as having occurred in Ireland:—

1. A. D. 1779, at Pettiswood, Westmeath; 6 oz.
2. August, 1810, Mooresfort, county of Tipperary; 7¾ lbs. Spec. grav. = 3·670.
3. September 10, 1813, Adare, county of Limerick; 17 lbs. + 65 lbs + 24 lbs.; moving E. to W. Spec. grav. = 3·64.
4. April 29, 1844, Killeter, county of Tyrone; fragments of one stone. Spec. grav. = 3·761.

Of the Meteorite that fell at Mooresfort, county of Tipperary, in 1810, the only analysis on record is one published by the late Professor Higgins, in the forty-seventh volume of the "Proceedings of the Royal Dublin Society," in whose Museum the greater part of this stone, and a cast of the entire, are carefully preserved.

Professor Higgins considered 35 per cent. of the stone to consist of metallic particles separable by the magnet. This would include the magnetic pyrites, iron, nickel, and chrome. In the Tyrone Meteorite examined by me, the iron, nickel, chrome oxide, and magnetic pyrites amounted to 35·40 per cent., which is very nearly the same proportion.

Dr. Apjohn has published a detailed account of his analysis of the Adare Meteorite in the eighteenth volume of the "Transactions of the Royal Irish Academy," from which it appears that the following is the mineralogical composition of that Meteorite:—

1. Meteoric iron and nickel, . .	23·07
2. Magnetic pyrites, ...	4·38
3. Chrome iron, ...	3·34
4. Earthy matrix, ...	68·47
5. Alkalies and loss, ...	0·74
	100·00

Its specific gravity varied from 3·621 to 4·230. The composition of the matrix of 200 grs. was found to be—

	Grs.
Silica, ...	78·19
Magnesia, ...	43·13
Protoxide of iron, ...	15·62
	136·94

George V. Du Noyer, M. R. I. A., F. R. G. S. I., Senior Geologist, Geological Survey of Ireland, presented to the Library of the Royal Irish Academy 100 Drawings from Original Sketches of Architectural Antiquities, to form Vol. VII. of a series of similar donations.

Mr. W. M. Hennessy read the following paper:—

THE CURRAGH OF KILDARE.

It must be admitted that our most authentic and ancient extant records contain little or no reference to the *original* establishment of the Curragh of Kildare as a theatre, or common, for the celebration of national games, sports, and pastimes; and no allusion whatever to its having been allocated, at any period, to the performance of the mystic rites of the Druidical religion. The presumption that it was ever devoted, either in whole or in part, to the latter purpose, rests on very slight evidence, as we shall see; but that it was allocated to the former practice—nay, has continued to be so for the space of at least 2000 years—is very certain. The obscurity which surrounds the origin of all monuments belonging to the pre-historic period necessarily attaches to the ancient history of the Curragh. We know at least as much regarding it as the English know respecting the monuments of Stanton Drew and Stonehenge—the latter of which is asserted by some of the early English Chroniclers to have been transferred thither from the "plains" of Kildare. But of its use, the race of men who erected it, or the date of its erection, notwithstanding the theory of its Saxon origin, which has lately occupied much attention, the people of Great Britain "know as much," remarks a recent writer, "as they do of the solid framework of the globe itself." And yet English history has had the benefit of such elucidation as Cæsar and Tacitus were able to afford. The works of their older historians—Gildas, Bede, and Nennius—also remain to the English, whilst many of our most ancient books of history are irretrievably lost. (See O'Curry's "Lectures," p. 20, for a formidable list of the Irish MSS. which have disappeared.)

The oldest *written* reference to the Curragh of Kildare that I have been able to find is a very brief one, contained in an ancient MS. called the "Liber Hymnorum," preserved in the Library of Trinity College, Dublin, and which is believed to have been transcribed in the tenth century, from a much older volume. It occurs in the celebrated Hymn in praise of St. Brigid, which professes to have been composed by St. Brogan Claen, from a prose narrative given to him by his master, St. Ultan, of Ardbraccan, in Meath. The latter died in the year A. D. 656, at a very great age; and it may therefore be safely assumed that St. Brogan's Hymn was composed not long after the year 600. It has been published by Colgan ("Trias Thaumaturga,") and contains internal evidence, if other testimony was wanting, of its antiquity. The "Martyrology of Donegal," in noticing the festival of St. Ultan, at September 4, states, "It was he that collected the miracles of St. Brigid into one book, and gave them to Brogan Claen, his disciple, and commanded him to turn them into verse; so that it was the latter that composed [the hymn], as it is found in the 'Book of Hymns.'" The reference to the Curragh is contained in the line "*In Cailloch reidhed Currech,*" i. e., "the nun who races over the Currech (or Curragh)." The scholiast, in a contemporary gloss on the word "Currech," says, "*Currech, a cursu equorum dictus est.*" Dr. Todd, who has quoted this gloss in his edition of the "Book of Hymns" (p. 67), remarks that this is "a curious proof of the antiquity of its use as a race-course;" "to which," he adds, "perhaps some allusion may be intended in the description of St. Brigid as 'the nun who *drives* over the Currech."' If the word *reidhed* had been translated "races," instead of "drives," Dr. Todd's suggestion would doubtless have been advanced with more confidence.

The next reference to the Curragh, in the order of *date*, is contained in the ancient philological tract called "Cormac's Glossary" (in Irish, "*Sanasán Chormaic*"), the authorship of which is ascribed to Cormac Mac Cuillenan, Bishop and King of Cashel, who was slain in the battle of Ballaghmoon, in the south of the county of Kildare, A. D. 908. This work, which is undoubtedly one of the most genuine fragments of ancient Irish literature that has descended to our times, has been edited by Mr. Whitley Stokes, from a MS. of the fourteenth century, in the collection of the Royal Irish Academy; but a fragment of it is preserved in the "Book of Leinster," a MS. in Trinity College, written about the year 1150. There is also a portion of this tract in a MS. in the Bodleian Library, Oxford, transcribed in the year 1453, and a valuable copy in Trinity College of the early part of the fifteenth century. We cannot at present claim to possess Cormac's autograph copy of the work; but Mr. Stokes, who has examined with critical exactness the historical arguments for and against Cormac's authorship, admits that, if absolute authority is wanting to prove that the tract was composed by Cormac himself, the internal evidence is such as to convince competent judges that it must have been originally written, if not in Cormac's time, within a century thereafter at most.

In this glossary the word *Currech*, or Curragh, occurs twice, and is thus explained, viz.:—

1. "*Cuirrech,* i. e. *a cursu,* i. e. *reidhe: Cuirrech, vero, do radh fri Sescend,* i. e. *corra rechait and,*" which, translated, reads "*Currech,* i. e. *a cursu,* i. e. running (or racing); Currech, indeed, is applied to a sheskin (morass), viz., cranes (*corra*) frequent it."
2. Cormac again has "*Cuirrech,* i. e. *a curribus,* i. e. *fich carpait,*" which means "Curragh, i. e. *a curribus,* viz., contest of chariots." The word "*fich*" is also glossed "*deine,*" ablative of "*dian,*"—swift, vehement; and the explanation of Cormac, therefore, plainly points to chariot races.

   In O'Davoran's "Irish Glossary," compiled in 1569, and also published by Mr. Stokes, "*Currach*" is explained "*Corr-iath,* i. e. *iath na corr*" (*corr-iath,* i. e. the land of the herons). This explanation is, of course, entirely fanciful, and the glossarist has even committed a very great error, grammatically, in identifying *Currech* with *Corr-iath.* The anonymous author of a curious Latin poem, in the possession of Lord Talbot de Malahide, written in the seventeenth century, an extract from which may be seen in Mr. Gilbert's "History of Irish Viceroys" (p. 511), derives the name of the Curragh "*a fessis equis,*" "from tired horses"—as if the word were compounded of *cortha* (pron. *corha*) "tired," and *ech,* "a horse."

Now, it cannot, I think, be doubted that, in furnishing an explanation of the word Curragh, and deriving it from "running" or "racing," the compiler of this glossary, who was probably no other than Cormac Mac Cuillenan, had the Curragh of Kildare in view; for, although there are countless places in Ireland bearing the name of Curragh, singly or in compound, to which the description "crane land" applies, or may have applied, I know of no other place so called to which the derivation *a curribus* can be held to be applicable. Cormac must have known the Curragh of Kildare well. He lost his life almost within sight of its green slopes; and the battle which proved fatal to him is asserted to have been caused by a dispute with the Monarch of Ireland, Flann Sionna, regarding the right of presentation to the neighbouring church of Monasterevan. Moreover, the Curragh of Kildare never was a sheskin, or morass. It was not a sheskin in 484, when St. Brigid founded her establishment on its borders, or for centuries anterior thereto. It was not a marsh in 705, when the Irish monarch Conghal, after devastating Leinster, apostrophized the Curragh as the "plain of the beautiful sward," in stanzas preserved by the Four Masters; nor was it a marsh in the seventh century, when it was the scene of a great battle; nor in the twelfth century, when Giraldus Cambrensis praised its fertility. In fact, the geological features of the surrounding country are opposed to the supposition that the Curragh was a marsh within the last 4000 years.

Cormac's second derivation of the name of Curragh, "a curribus," which he explains by "*fich carpait*," or "chariot contests," suggests the inference that chariot racing preceded simple horse racing in this country—an inference which is highly probable. The very ancient MS. known as *Leabhar-na-h Uidre*, now in the Academy's collection, contains a remarkably valuable historical tale called "*Toghail Bruidhne Da-Derga*," or the "demolition of the mansion of Da-Derga," a Leinster chieftain who dwelt in the valley through which the River Dodder flows, about three miles above Tallaght. The late Professor O'Curry, in describing this tract, observes that "its composition must be referred to a period of very remote antiquity, the style of the construction and language being more ancient even than the *Tain-bo-Cuailgne* (which is generally regarded as the oldest Irish tale); and of a character," he adds, "totally beyond the power of ordinary Irish scholars to reduce to anything like a correct translation." I venture to entertain the belief that the *Bruidhen Da-Derga* is, perhaps, the oldest Irish text now remaining. The phraseology betrays no indication of the existence of Christianity in Ireland at the time of its composition. It professes to give an account of the destruction, by a band of pirates, of Da-Derga's *Bruidhen*, or mansion (the name of which is supposed to be still preserved in that of the village called "Boher-na-breena," or "the road of the mansion"), and the murder of the Irish monarch, Conary Mór, whose death Roderick O'Flaherty refers to the year A. D. 60. I allude to this old tale, because it represents Conary as having on one occasion gone with four chariots to his "*cluiche*," or games, to the Curragh, "i Lifiu" (i. e. in the plain of Liffey), as the expression is.* The "cluiche" comprised all kinds of games, sports, and exercises, anciently performed at the *Aenach*, i. e. fair, or assembly—whether convened on the occasion of a national festival, the accession of a king, or for the purpose of holding the *Aenach gubha*, "fair of sorrow," or funeral rites, of some deceased chieftain; but in either case the inevitable "races," or "*graifne*," formed a conspicuous element in the celebration.

At the period to which I refer, namely, the middle of the first century, and during at least 200 years subsequently, chariot races would seem to have been the system of racing in vogue. Nay, from the existing records, the chariot would appear to have then constituted the universal means of locomotion in this country. The explanation of this may be found in the fact, if such it is, stated in *Leabhar-na-hUidhre* (fol. 68, aa), that there was neither ditch, fence, nor stone wall erected in Ireland before the reign of the sons of Aedh Slaine (*circa* 660), but that the land was all in level tracts; and that fences then became necessary as boundaries, owing to the multiplicity of houses. The erection of fences would of course tend to diminish the usefulness of the kind of chariots then in use, which we may well believe, notwithstanding the glowing description left to us of the chariot of Cuchullain, to have been little better than the heavy waggon of the Roman husbandman: —

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* Lifé was the old name of the plain of Kildare; and the river flowing through it, anciently called Ruirtech, thus obtained the name of "Amhain Liffé," or "River of the Liffé."

> "Tardaque Eleusinæ matris volventia plaustra."

Be that as it may, when we come to the time of Cormac Mac Art, and the genuine Fenians, that is to say, about the year 260, we find the chariot races apparently superseded by horse racing; for, whereas in our accounts of the true epic period of Irish history—terminated by the so-called Attacotic rebellion in A.D. 90—chariot races only are mentioned, the stories of the Fian, and pieces of more genuine history of the period, represent horse races as the delight of kings and chieftains; and whilst Conor Mac Nessa and the heroes of the *Craebh Ruaidh*, or "Red Branch," are praised for the number and beauty of their chariots, Finn Mac Cumhail and his friends are complimented on the symmetry and fleetness of their steeds.

The evidences on this point are numerous; but I shall only adduce one piece, and this simply as bearing on the subject more immediately under consideration. The oldest specimen of Ossianic poetry with which I am acquainted is a poem contained in the "Book of Leinster"—a twelfth-century MS. in Trinity College Library—in which Ossian laments his blindness, and expresses his regret that he cannot enjoy the *Aenach*, or Assembly of the Liffey, *i.e.*, of the Curragh, which he represents as having been inaugurated on the occasion by the King of Leinster. Then he narrates a visit which he paid in his younger days, with his father, Finn, to the assembly of *Aenach-Clochair*, now Monaster-an-enagh, near Croom, in the county of Limerick, where horse races, or "*graifne*," were got up in honour of Finn's visit. Thence they proceeded, adds the poem, to Tragh Beremhain, probably the ancient name of Ballyeigh strand, in Kerry, where another horse race took place, and where indeed the good old practice is still kept up. The copy of this poem which we now possess is of course not more than 700 years old; but who can fix the age of the original from which it was then transcribed into the "Book of Leinster?" The statement that the public games celebrated on the Curragh were inaugurated by the king can be supported by many references of a similar kind. Indeed, the office of presiding over such assemblies was part of the duty of a king, according to the Brehon Laws; and there are not a few entries in our annals where a king is said to have been killed by a fall from his horse at an *Aenach*. This is also further confirmed by a clause in the well-known testament called the "Will of Cathair-Mór, King of Leinster," and subsequently Monarch of Ireland, who died about the year 174, who bequeaths to his son Crimthann, amongst other bequests, "the leadership of the games of the Province of Leinster," which I take to include the games of the Curragh. This remarkable document has been published in the "Book of Rights," by Dr. O'Donovan, who observes, in the preface, that it must have been written some centuries after Cathair's time; but O'Flaherty treats it as a document contemporaneous with the testator; and it is evident that the copy which the learned author of "Ogygia" possessed was more ancient than O'Donovan's texts, as the clause in which Cathair bequeaths to his son Crimthann, "Potestas, qua ludorum præfectus per Lageniam erat constitutus," is not found in the later copies.

There is another very ancient poem contained in the "Book of Leinster," in praise of St. Brigid, the various Kings of Leinster, and the more important places in it, including the Curragh. The author's name is unfortunately not given; but I have little doubt that it is the composition of one Orthanach, another of whose productions is also preserved in the same MS., although in vol. v. of the Academy's "Proceedings," page 171, it is stated that no mention of this writer occurs in any known document except in an Irish MS. in the Bodleian Library. There are two persons of the name mentioned in the "Annals of the Four Masters"—Orthanach of Cill-Foibrich, or Kilbrew, in Meath, whose obit is given at the year 809; and Orthanach, Bishop of Kildare, who died in 839. I think the latter, who in the Bodleian MS., is called "Orthanach of the Curragh of Kildare," was certainly the author of of this poem, as it manifestly appears to be the production of an ecclesiastic, and to have been written before the year 835, when St. Brigid's remains were transferred for safety to Downpatrick, as the writer expressly refers to Kildare as her *ruaim*, or place of sepulture.

The author apostrophizes St. Brigid, salutes her as the princess of the men of Leinster, and states that, although to her *then* belonged the plain of the Liffey, which he afterwards refers to as the Curragh, yet *before her time it belonged to all in succession*—

"*Indiu cid latt Liphe Lir,*
Ro bo thir caich ar nuair."

which I understand as signifying that it was a common before the time that the people of Kildare came to regard it as the appanage of their patroness, from which period it has undoubtedly continued to be so.

After enumerating some of the kings who reigned over the Curragh, *i. e.*, over Leinster, the poet adds—

"*Marid Cuirrech cona li,*
Ni mair nach Ri ro boi foir."

"The Curragh, with its beauty, remains;
But there lives no king who was over it."

The verdure of its sward, and the shouts of its assemblies, are also mentioned, as well as the curious condition which seems to have been imposed by custom on any celebrated stranger visiting the Curragh, which consisted in his having to perform a "*cor*," turn, or circuit round it. From this word "*cor*," or circuit, some persons might be inclined to derive the name of "Curragh;" and it is true that the old road leading from the Priory, or graveyard, of Kildare, towards the Curragh, is still called Bohereen-na-gcor," or "the little road of the turns (or circuits);" but the very ancient authorities of Brogan Claen and Cormac forbid our setting aside their explanation of the word Curragh.

Local tradition assigns the honour of making the Curragh a common to St. Brigid, who is represented as having received from the King of Leinster, for removing a deformity under which he laboured, as much land as her mantle would cover; and it is added that but for a rent made in the garment, through the avarice of one of her female companions, the entire surface of Ireland would have been embraced in its folds. There is no reference to this alleged grant in any of her lives. In most of them, however, she is stated to have had pastures on the Curragh, to which she never prevented the neighbouring people sending their cattle. Both history and tradition here plainly point to the fact of the Curragh having been a common from the year 484, when Brigid founded her little church of wattles beside the old oak of *Druim Criadh* ("Ridge of Clay"), as Kildare was anciently called. It is probable, also, that St. Brigid did not interfere with the races, whatever may have been the case as regards the other Pagan celebrations; for, although she is represented by her biographers as "never for one moment diverting her attention from holy contemplation, but in constant converse with God by meditation in heart and mind," her ancient lives prove that she was not averse from riding in her chariot over the Curragh, or opposed to the exercise of legitimate amusement being practised there; and indeed the "*faitche*," or "green," formed an adjunct to the old church or monastery, as well as to the *Dun*, or residence of the chieftain. Nor were the races discountenanced, apparently, by her successors, some of whom are occasionally dignified by their biographers with the agnomen "Cuirrethach," or "the racing," as the Abbot Cobhthach, who died in the year 868, and a fragment of whose elegy is preserved by the Four Masters, in which he is called "*Cobhthach Cuirrigh Cuirrethach*"—*i. e.*, "the racing Cobhthach (or Coffey) of the Curragh." Besides, we have it on record that kings were sometimes accompanied by the "chiefs of the clergy and laity," when celebrating the *Aenach*, or games.

It appears from the most ancient Irish MSS., that from a very remote period every province in Ireland possessed an *Aenach*, "fair green," or arena, where the men of the province, old and young, assembled at stated times, under the leadership of the king, to celebrate their festival games. And such was the regularity with which these celebrations were held, that whenever intermitted on account of wars or other inevitable causes, the Annalists deplore the circumstance in feeling terms. In the old list of Irish Triads, contained in a stave of the "Book of Lecan" (which by some chance has got inserted into the vellum MS. classed H. 2, 17, in Trinity College Library), the three great *Aenachs* of Ireland are stated to have been *Aenach Croghan*, in Connaught; *Aenach Taillten*, in Meath; and *Aenach Colmain*, or the fair of the Curragh. The green of Croghan, in Roscommon, was frequented by the people of the trans-Shannon district; that of Taillten, or Teltown, in Meath, in which Tara, the ancient seat of the Irish monarchy, is situated, was the principal place of assembly for *Leath Chuinn*, Conn's half, or the northern part of Ireland; and the Curragh served for the southern half, called *Leath Mogha*, and probably for the whole country. I may observe that the games of Taillten, or Teltown, continued to be celebrated every first of August, down to the end of the twelfth century. Even from that period hurling, wrestling, and other manly sports were annually carried on there up to a recent date; and the Hill of Lloyd races may possibly be a relic of the ancient practice. In addition to these principal places, each sub-territory had also its special arena. The men of Northern Ulster assembled at Emania, now the Navan Fort, near Armagh. The tribes about the now county of Limerick congregated to *Aenach Clochair*, now Monaster-an-enaigh, near Croom. The inhabitants of Hy-Kinsellagh, or Southern Leinster, met at Loch Garman, or Wexford; and the place where they enjoyed their games is still called the Fathy, or *Faitche, i.e.* "fair green" of Wexford. The green of Cashel is also celebrated in history, as well as that of *Aenach Urmumhan*, or the *Aenach* of Ormond; from which word *Aenach*, or *An-Aeanach*, the name of Nenagh is derived.

The dates at which all these places were founded—except the Curragh—are given, and range from some centuries before the Christian era to A. D. 400; but no reference to the exact period when the Curragh was established as the Olympian theatre of the Irish is to be found in our MS. remains. Dr. O'Donovan, who devoted much attention to the elucidation of its history, was only enabled to conclude that it was a plain from the most remote age. However, it seems to have been used as a national arena in the century before Christ, when Art, son of Mesdelmond, fixed his residence on Dun Ailind, or Knock Allen, on its eastern border, to which an old road, still traceable, led through the Curragh. The ancient tract, called the "Dinnsenchus," originally compiled in the sixth century, of which we have a copy in the "Book of Leinster," contains a poem on the erection of *Dun Ailind*, or *Knock Allen*, in which occur the lines,

"*Aillend aenach diar nogaib*
Raith Airt cona Righ rodaibh."

"Ailind, place of assembly for our youths—
Rath of Art, with its royal roads."

There is no doubt, I think, that the celebrity here claimed for *Ailind*, as a place of assembly, or *Nundinæ*, is borrowed from the character of the Curragh which stretched before it, as Knock Allen is too steep to have ever served as a place for the celebration of the games appropriate to an *Aenach*.

The places of public assembly, as I have remarked, were generally confined to the inhabitants of the respective districts; but it would seem that the Curragh was frequented by people from all parts of Ireland. Thus Conary Mor and his companions who belonged to the northern division, are represented as having attended its games. We have it on very ancient authority that two centuries later the promiscuous band of Finn was in the habit of participating in the sports. The "Book of Munster," as preserved in the "Book of Lecan," states that Fiacha Fidh-gheinte, ancestor of the O'Donovans, and other chief families of Munster, and who lived in the fourth century, obtained the surname "*Fidh-gheinte*," which is supposed to mean "wood maker," "*quia fecit equum ligneum in Circino Colmain, in Campo Liphi.*" The explanation may appear fanciful, and suspiciously suggestive of Epeus and the Trojan horse; but it nevertheless implies that the writer knew the men of Munster were admissible to the sports of the Curragh. Again, at the year 825, the Annals record the destruction of *Aenach Colmain*, i. e. the Assembly of the Curragh, by Muiredhach, King of Leinster, against the South Leinstermen, on which occasion many were slain. South Leinster was at that time, and had been for 600 years previously, a distinct kingdom, and had its own place of assembly at Loch Garman, or Wexford. Its people are stated to have celebrated the Curragh games also on other occasions without interruption; and the contention in 825 may have been owing to their having dispensed with the usual inauguration by the local sovereign, as the disturbance of a fair, without weighty reasons, was severely punished under the Brehon Laws. In the year 954, also, Congalach, Monarch of Ireland, is recorded to have proceeded into Leinster, and held the "fair of the Liffey," or Curragh, for three days; and, although the Leinstermen did not interfere with the celebration, Congalach, at their instigation, was intercepted by the Danes of Dublin, on his return home, and slain at *Ailen-tighe-Giughrain*, which was very likely the ancient name of Inchicore, near Dublin. Hence it would appear that all comers were free to make use of the Curragh for the purposes to which it was adapted.

It is not necessary to the object of this paper to refer to the many occasions on which the Curragh of Kildare was the theatre of more hostile assemblies. Situated almost on the boundary of the warlike kingdoms of Meath, Leinster, and Offaly, it formed a convenient battle ground for rival armies. Neither shall I detain the Academy in attempting to define the character or origin of the tumuli with which its long ridge is dotted, and which, not being ramparted, are supposed to have been used, not for purposes of residence, but as places of interment.

The fame of the Curragh as a Druidic establishment does not rest on a very strong foundation. Moore, in his "History of Ireland," vol. i., p. 28, has given currency to the notion. "One of the old English traditions respecting Stonehenge," he says, "is, that the stones were transported thither from Ireland, having been brought to the latter country by giants from the extremity of Africa; and in the time of Giraldus Cambrensis there was still to be seen, as he tells, on the plain of Kildare, an immense monument of stones, corresponding exactly in appearance and construction with that of Stonehenge." Giraldus, however, does not say that the monument was there in his time, but that there was in ancient times a stupendous pile on the plains of Kildare, near Naas, and that "certain stones," "*quidam lapides*," exactly resembling the rest, were there in his time; and although it has been supposed that the "Nasensi" of Giraldus was a misreading of "Darensi" or "Darensis," as Kildare is usually Latinized, it is likely that "Nasensi" is right; and that, by placing the locality close to Naas, Giraldus meant either the enormous pillars still remaining at Fornaught, or perhaps those at Punchestown.

But the account which Giraldus gives of the removal of the Stonehenge monument from Ireland is copied from the "Historia Britonum" of Geoffrey of Monmouth, who represents Uther Pendragon as having come over here, by the advice of Merlin, and transported the monument from the mountain of Killarus (probably the Hill of Fornaught), after having defeated Gillomanius, who then reigned in Ireland. As an instance of the untruthfulness of Geoffrey's statement, I may observe, what Mr. Charles Haliday was the first to notice, that the word Gilla, "*servus*," or "*puer*," is not found in the composition of any Irish proper name prior to the advent of the Danes, from whom it was probably borrowed; and no name beginning with "Gilla" appears in the Irish Annals before the end of the ninth century.

Writing of Kildare, Giraldus observes, "In this neighbourhood there are some very beautiful meadows, called 'Brigid's pastures,' in which no plough is ever suffered to turn a furrow. Respecting these meadows, it is held as a miracle that, although all the cattle in the province should graze the herbage from morning till night, the next day the grass would be as luxuriant as ever.

"Cropt in a summer's day by herds, the dew's
Refreshing moisture verdure still renews."

It is to be regretted that this excessive fertility does not still characterize the Curragh, which is locally called "the short grass;" and the young men of Kildare are known as "the boys of the short grass."

The Curragh seems also to have been regarded by the Anglo-Normans as a common pasture; and Mr. Gilbert, in his valuable "History of the Irish Viceroys" (p. 510), has published a curious Parliamentary decree of the year 1299, in which it is expressly so called:—"Inhibitum est, sicut antiquitas fieri consuevit, quod porci de cætero non pascant in Coraghto de Kildare, quod est communis pastura, et in solio Domini Regis. Et vicecomes puniat illos qui porcos suos fugent vel habeant ibi fodientes vel pascentes, prius per finem, et postea per amissionem porcorum illorum, et gravius si sæpius sic delinquant."

Among the Ordnance Survey papers in the collection of the Academy is preserved a curious tract called a "Descriptive Account of the County of Kildare," drawn up for Sir William Petty, by a Mr. Thomas Monk, in the time of the seventeenth Earl of Kildare, and therefore between the years 1660 and 1664, in which the Curragh is thus referred to:

"Near the centre of this county is the Curragh of Kildare, a large spatious plaine, and common to all the adjacent neighbourhood, who find it a rich and commodious, as well as healthful pasturage, especially for sheep, that bear a fine staple, and the finest flesh of any in the kingdom—it being thronged with flocks all the year round. It is about nine miles in compasse, and togeather with the adjoyneing grounds, is reckoned one of the most pleasant sytes these kingdoms anywhere can shew: the easie assents yeildinge noble and various prospects, and the gentle declineings give content to the wearied traveller, as well as recreate and please the gentiele horsman and keeper; it being a place naturally addapted to pleasure; and its vicinity to Dublin—being but seventeen miles distant—occasions that hither repaires the Lord Lieutenant, or Chiefe Governor, when his Majestie's important affaires will admit leisure to unbend, and slacken from trying cares. Hither are also seen to come all the nobility and gentry of the kingdome, that either pretende to love, or delight in hawking and hunting, or raceing; for in this clearer and finer aire, the falcon goes to a higher pitch, or mount, soe as often to be scarce visible; the hounds enjoy the scent more freely, and the courser, in his swift carreare, is lesse sensible of pressiure or opposition then other where."

A few years previously also, *i.e.* in 1657, the Commissioners appointed to carry out the Act of Settlement returned the Curragh as a pasturage common to various towns, although in the reigns of James I. and Charles I. the right of pasturage thereon was granted to certain patentees; but it would seem that these grants were re-grants of rights previously forfeited.

It remains to say a word as to the extent of the Curragh. It comprises at present 4885 acres; but it seems likely that it was anciently much more extensive. Dr. O'Donovan and others have been of opinion that the Curragh extended to the River Liffey on the eastern side, as it is referred to in the ancient records as being *ar bru Lífé*, *i.e.* "on the brink of the Liffey." But the expression *ar bru Lífé* is only relatively used, in the same way as Glasnevin is described in the "Martyrology of Donegal" (p. 272), as "*for bru abhainn Lífé*," "on the brink of the River Liffey," although it is much farther from the river than the present eastern limits of the Curragh. It is very probable, however, that the Curragh extended in another direction as far as the town of Kildare. St. Brogan asserts in his hymn that St. Brigid built her establishment in a plain, "in campo extruxit suam civitatem." There are many notices in her lives, implying that the land in immediate contiguity to her church was a plain. This is also supported by a scholium at the 1st of February, in the Festology of Aengus Céle Dé, a copy of which is preserved in a twelfth-century MS. in the Bodleian Library, which represents the saint's cows as having on one occasion given so much milk, that the surplus, after filling all the pails, formed the lake called

Loch Lemnachta, or "New-milk Lake," to the north of the place. The lake in question is probably the small sheet of water now called Loch Minnaun, or the Lake of the Kids, lying a few perches to the north-west of Kildare; and as it is represented as having been in or near "Brigid's pastures," it may have probably been within the ancient limits of the Curragh.

I may close the present paper with the following extract, already published in Mr. Gilbert's "Viceroys," from the Latin poem in the possession of Lord Talbot de Malahide, to which I have already referred :—

"Est locus almus apex ubi se Kildarius astris
Inserit et socium lambunt fastigia cœlum,
Quem prope campus adest, immensi jugeris æquor,
Vomere quem nulli, vel adunci vulnere aratri,
Sulcavere boves; nullæ secuere lacunæ.
Non illic surgunt virgulta, lapisve superstes
Limes, agro positus ; nullis hic terminus arvis ;
Terra patens, præbens promiscua pascua, nullo
Limine septa scrobis, sed toti libera regno.
Si foret hic lapidum jactu reparanda virum stirps
Perdita diluviis, hic frustraretur inanis
Deucaliona labor; silices nec Pyrrha morandis
Hoc reperire queat, mulieribus irrita, Campo.
Planities tantum in spatium se extendit utrinque,
Quantum oculus nusquam cernit. Confinia metæ
Tam longinqua patent ; facies tamen unica campi est
Qualis tranquilli pelagi tenor, Æole, vestris
Flatibus, immunis solet esse et flamine quovis.
A fessis, huic nomen, equis, vernacula quondam
Lingua loco dederat, quem Graia vocabula rite
Hippodromum indigetant, a quadrupedante frequenti.
Scilicet hæc toties prata ungula trivit equorum
Lassa Geraldiadum, cum se Mavortia pubes
Exerceret ovans; et equis, quæ maxima virtus,
Expertura suis varium certamen iniret."

Thus translated by Denis Henry Kelly, Esq. :—

"Where soars the ancient Tower of Kildare,
Amidst the stars, and leaves in 'ts kindred Heaven
Its trace, a place there is most passing fair;
And near 't, a level plain of many an acre,
Which coulter ne'er, nor oxen with curved share
Have into furrows riven; there no dykes
Have e'er been cut; no brushwood rises there;
No stone stands, planted as an ancient landmark;
No bound'ries here to point out sep'rate fields.
In common past'rage open lies the land,
Nor hedge, nor ditch is there—all, all is free!
If here Deucalion, to renew man's race,
Sought stones to cast behind him, vain his task!
Nor in this plain could Pyrrha flints have found,
To supersede, how vain! the female sex.
So far around this plain, on every side,
No eye of human being can descry
Its limit—the great stones upon its confines

So far asunder stand! One likeness has it,
And only one, which in the least comes near it—
The calm blue sea, O Æolus, which stands
By any breeze or breath of thine unruffled.
Its name, from wearied steeds, the Curragh takes—
A name of yore in tongue vernac'lar given,
But which in Greek is called an Hippodrome—
Because this plain on ev'ry side 's cut up
By the tired hoofs o' th' Geraldines, when there
That martial race, exulting, exercise
Their steeds, and try their mettle—thus to test
Which fleetest is, ere ent'ring for the Stakes."

In conclusion, I have to regret that the references to the Curragh are so few and fragmentary, that the most diligent search has not enabled me to present to the Academy a more specific account of its history and antiquities than the present imperfect sketch.

Mr. Eugene Alfred Conwell read a paper, entitled

EXAMINATION OF THE ANCIENT SEPULCHRAL CAIRNS ON THE LOUGHCREW HILLS, COUNTY OF MEATH.

PART I.

Subjoined are extracts from this paper, and an abstract of other details:—

. . . .

In the extreme north-west angle of the county of Meath, commencing about two miles south-east of the neat and flourishing little town of Oldcastle, and directly overlooking the beautiful demesne of Loughcrew, there runs from west to east a range of hills, about two miles in extent.

The highest peak, known as Sliabh-na-Cailllighe, attains the height of 904 feet, and, being the only eminence in the county assuming the name or character of a mountain, forms a prominent feature in the landscape. The whole range consists of Lower Silurian rocks, which occupy a large extent of country in the neighbourhood. On the north the slate rocks form the low grounds round Lough Ramor, while to the south and west lie the comparatively low, undulating, limestone plains of Meath and Westmeath.

The prospect from the summit of any of the peaks is not to be surpassed in any other locality in the country. For pastoral beauty it is unrivalled: while, for comprehensive extent of view, perhaps, no other point in the kingdom could have been so well selected for the necropolis of the chiefs who inhabited the central prairies of Ireland. The mountains overhanging the bays of Carlingford and Sligo are visible, giving a telescopic view of Ireland from sea to sea, about its narrowest part. Persons knowing the country well are accustomed, with the aid of a clear horizon, to point out from these hills elevations in eighteen out of the thirty-two counties in Ireland. This is not surprising, as it can be easily shown by trigonometry that the square root of once and a half the height in feet of any elevation on the globe's surface is equal to the distance of the offing, or sensible horizon, in miles; and thus Sliabh-na-Cailllighe, having an altitude of 904 feet, commands a view of at least thirty-seven miles all round, in a perfectly clear atmosphere, not taking into account that atmospheric refraction would increase this distance by about three miles. Now, a circle of thirty-seven miles in radius, swept round Sliabh-na-Caillighe on the map, will include within its range, or nearly touch, the counties of Fermanagh, Tyrone, Monaghan, Armagh, Down, Louth, Meath, Dublin, Wicklow, Kildare, King's County, Queen's County, Westmeath, Roscommon, Sligo, Longford, Leitrim, and Cavan. Following up this line of calculation, any mountain attaining the height of 2000 feet, under favourable circumstances, might be visible, if not more than ninety-two miles distant; which would include every mountain of 2000 feet in height and upwards in every county in Ireland, except in Cork and Kerry.

Such a site, however, was no doubt selected in order that these great tombs might form conspicuous objects in the horizon from the greatest possible number of places.

My first visit to these remarkable hills was on a pic-nic excursion, accompanied by my wife, and was made on Tuesday the 9th of June, 1863; when, to my great astonishment, I found this commanding site studded with the remains of a necropolis of pre-historic age, greater in extent than anything of the kind yet thoroughly examined in Europe.

Although at a distance of about twenty miles from my home, I soon afterwards paid as many visits to the place as my limited time and the inconvenient distance permitted me to do—some of the results of which I have already had the honour of laying before this Academy on two former occasions.

When I first stated that I had discovered a series of hitherto unnoticed and undescribed cairns, extending for two miles along a range of hills, within forty miles of the city of Dublin, I was laughed at, naturally enough. I can only attribute their being left for me to investigate to the fact that, up to the time the omission was drawn attention to by me, the only indication of their existence on the Ordnance Survey Maps was a mere dot or two, with the word "Stones" appended: and the local knowledge of their origin and use went no further than what the late eminent Dr. O'Donovan so humorously describes in one of his "Letters containing information relative to the antiquities of the County of Meath, collected during the progress of the Ordnance Survey," of which I submit a copy—writing of the parish of Loughcrew.

"*Kells*, 30*th July*, 1836.

. . . .

"There are three hills about a mile asunder in this parish, having three heaps [carns] of stones on their summits, with which the following wild legend is connected. A famous old hag of antiquity, called Cailleach Bhéartha (Calliagh Vērǎ), came one time from the North to perform a magical feat in this neighbourhood, by which she was to obtain great power, if she succeeded. She took an apron full of stones, and dropped a *carn* on *Carnbane;* from this she jumped to the summit of Slieve Na Cally, a mile distant, and dropped a second carn there: from this hill she made a second jump, and dropped a carn on another hill, about a mile distant. If she could make another leap, and drop the fourth carn, it appears that the magical feat would be accomplished; but, in giving the jump, she slipped and fell in the townland of Patrickstown, in the parish of Diamor, where she broke her neck. Here she was buried; and her grave was to be seen not many years ago in the field called Cúl a' ṁóta (*i. e.* back of the moat), about two hundred perches to the east of the moat in that townland; but it is now destroyed.

"This is the very old lady whose shade still haunts the *lake* and carn of Slieve Guillion in the county of Armagh. Her name was *Evlin*, and it would appear from some legends about her that she was of De Danannite origin.

"She is now a Banshee in some parts of Ireland, and is represented in some elegies as appearing before the deaths of some persons. I know nothing more about her, but that on one occasion she turned the celebrated Fin Mac Cooil into a grey old man; but his soldiers dug through the mountain of Slieve Guillion in Armagh until they drove her out of her cave, and forced her to restore Fin to his former beauty and symmetry.

"Does her name, Eiḃlín bheurṫa inġin Ghuilinn, appear in the genealogies of the Tuatha De Dananns?

"A quatrain of her poetic composition is yet repeated at Carnbane, but I calculate it is a post-original:

Mise Cailleaċ Ḃhéurṫa ḃoċt
Iomḋa iongnaḋ ḋ' aṁarcas riaṁ
Chonaicear Cárn bán 'na loċ
Giḋ go ḃfuil anois 'na ṡliaḃ.

'I am poor Cailleach Bera,
Many a wonder I have ever seen—
I have seen Carnbane a lake,
Though it is now a mountain.'

What a pity that she is not alive now to throw light upon geology! Could Mr. Curry, from his vast knowledge of fairyology and *hag*iology, give me any account of the old *hag* who left her name on this range and on Slieve Guillion?

"There is an eminence in the townland of Knocklough called Slieve Guillion, and a rude *stone chair* on the summit of Slieve Nacally called caṫaoir na cailliġe beurṫa, *i. e. Calliagh Bera's Chair.* It is a large stone, about two tons weight, ornamented with a cross sunk (cut) into the seat of the chair, in which three might sit together. This hollow seems to have been made in the stone with a hammer: the cross is probably the work of a modern stonecutter. The back of the chair was broken by some human enemy to old Evlin."

That this enumeration of the cairns was very imperfect, we shall see presently; and it may not be uninteresting in this place to allude to some broken stanzas with which I have been furnished, having the following local tradition associated with their authorship. Mr. Winslow, a gentleman of antiquarian tastes, was living in the early part of the last century near Fore, about seven miles west of Sliabh-na-Cailllighe. On one occasion he invited Dean Swift, who was then sojourning with his friend, Dr. Thomas Sheridan, at Quilca, in an adjoining district of the county of Cavan, to join him in visiting Sliabh-na-Caillighe, in order to collect the fables related about the place, and the monster woman—Garvogue—who formerly reigned there. Sheridan, who was of the party, availing himself of his knowledge of Irish, acted as interpreter; and Mr. Winslow prevailed upon the Dean to turn into verse the legends collected on the ground. The following is all that could be deciphered from the manuscript of Thomas Farrelly, who was gardener at Quilca at that time:—

"Twelve giant elks, trained to the car,
Had brought the warlike dame from far
Bengore—where reigned the dreadful war.

. . . .

When morning dawned, the board was spread
With cresses, nuts, and berries red;
And Garvogue left her heather bed.

. . . .

Black Ramor, Crewe, and glassy Sheel
Sent up the bream, the brac, and eel,
At mid-day for her ample meal.

. . . .

Twelve haunches of the fattest elk,
Twelve measures of the richest milk,
Twelve breasts of eagles from the height,
Composed the meal for eve or night.

. . . .

Ere Finn and Gall had raised the spear—
Ere Caolta chased the mountain deer—
Titanic Garvogue held her sway—
The feast at night—the chase by day.

. . . .

Her pack just numbered threescore ten—
No fleeter ever crossed a glen:
Red Spidogue, with her broad, full, chest,
And Isogue, round ribbed, and the best.

. . . .

Determined now her tomb to build,
Her ample skirt with stones she filled,
And dropped a heap on Carnmore;
Then stepped one thousand yards, to Loar,
And dropped another goodly heap;
And then with one prodigious leap
Gained Carnbeg; and on its height
Displayed the wonders of her might.

. . . .

And when approached death's awful doom,
Her chair was placed within the womb
Of hills whose tops with heather bloom."

I have also heard these lines attributed to Miss Brooke, daughter of Henry Brooke (a pupil of Dr. Sheridan's), who was then living at Mullagh, about two miles from Quilca. As possessing local interest, I submit them; although I suppose they have been corrupted since they were originally written.

During the course of the past summer I have had the good fortune to secure the valuable co-operation and indispensable assistance of the owner of the property, James Lenox William Naper, Esq., D. L., Loughcrew, by which means I have been enabled to make a more thorough examination than I had hitherto done of these archaic remains. Mr. Naper communicated with his agent, Charles William Hamilton, Esq., J. P., Hamwood, Clonee, accompanied by whom, and by my friend George V. Du Noyer, Esq., I again visited the Loughcrew Hills; and on consultation with Mr. Naper, who in the most generous and enlightened manner supplied the material aid in labour, a systematic plan of examining all the cairns on the hills was determined upon.

My own personal thanks are very eminently due to Mr. Naper and to Mr. Hamilton for the great interest they evinced in the progress of the work, visiting the hills nearly daily, and supplying, during the latter half of the month of September, as many men as with safety and convenience could be employed.

Mr. Hamilton communicated with Colonel Sir Henry James, R. E., as to the omission of these cairns on the Ordnance Survey Maps; and, during the time that I recently spent in their investigation, a sapper was sent from the Ordnance Department, Phœnix Park, with instructions to remeasure the hills, and to insert the cairns on a map $\frac{1}{2500}$, or 25·344 inches to a statute mile. A copy of this map is now before the Academy; and having, in my former description of the place, only roughly measured distances, &c., by stepping them, I now avail myself of the more accurate measurements of this map in the details which are to follow.

The map accompanying this paper has been reduced from the large map to a scale of 2·64 inches to a statute mile.

In my first notice of these hills I made use of the letters of the alphabet in naming the cairns; but, having since found that there are remains of others not included in that description, I am now obliged to mark these with index figures to some of the letters, in order that the same letters as formerly used may still apply as the names of the cairns. The hill on the western extremity of the range, attaining a height of 842 feet, is situated in the parish of Loughcrew, and is called Carnbawn. Here I have commenced to describe the relative positions and dimensions of the cairns.

A.

Nearly all the stones which formed this cairn have been removed. Its present remains are seven yards in diameter, and are situated sixty-six yards south-east of D. Four large stones still remain, marking out the circumference of its base.

A^2.

In a plantation, at a distance of 130 yards south of D, the remains of a cairn are visible, but nearly level with the ground. It is nine yards in diameter. One large stone still stands upright on the circumference, and bears some evidences of apparently ancient sculpturing; but, as they are doubtful, I have not taken further notice of the markings.

A^2.

On the southern scalp of the hill, in a most conspicuous position, sixty yards south-west from D, and nearly close to the southern side of the present deer-park wall, once stood a cairn, twenty-two yards in diameter. Its present remains are not more than a foot or two in height, consisting of small rubble stones, the *debris* of the former cairn, which is now covered with green grass.

B.

Forty-six yards to the west of D are the remains of a cairn seven yards in diameter. The loose stones which formed it are nearly all gone, leaving in the centre three large flags, laid on edge, forming a chamber twelve feet in length, and two feet in breadth, pointing in the direction of E. 20° S.

. . . .

In clearing out this chamber several fragments of charred bones were found mixed with the earth at the bottom. Two of these I present as specimens, as they appear, as well as all the others found here, to have assumed an unusual degree of heaviness.

C.

Sixty yards to the south-west of D will be found the remains of a cairn, five yards in diameter. Nearly all the stones have been removed, leaving only four large stones still marking the site. At the distance of twenty-five feet to the north of the cairn now lies prostrate a pillar stone, which, like the celebrated Menhir* of Quintin (Côtes du Nord) which is nine metres over ground, formerly stood upon its smaller end. It measures seven feet long, three feet six inches broad, and one foot thick.

D.

This has been the largest of all the cairns in the range, the diameter of its base being sixty yards. The north and east sides have been [redacted]

Accordingly, about a dozen labouring men commenced to remove the stones, and to make a passage inwards from this point. As they advanced in this way into the cairn, the loose stones composing it occasionally fell in dangerous masses, filling up excavations already made; so that it was at length determined to make a cutting right through the cairn, running east and west, and commencing on the top. After two weeks spent in this labour, and with as many men as could be conveniently engaged at it, I regret to say, as I could not then remain longer, that we did not come upon any of the interior chambers; but, at the same time, the cutting had not reached the bottom—though nearly so—of the cairn; and I have little doubt that at no very distant date Mr. Naper will continue the exploration. This, however, is now the only one of all the cairns left unexamined.

As the cutting proceeded, about midway down among the loose stones, were found portions of a large skull and twelve teeth of a graminivorous animal, probably of an ox, sacrificed on the pile.

At a distance of 105 feet to the north-west of this cairn, and on the very point of the escarpment of the hill, stood a pillar of quartz, eight feet high, three feet broad, and two feet thick. How far it may have entered the ground when being placed there, I have not ascertained. At present it is broken across a little above the ground, and now lies as it fell. It might be interesting to consider whence it could have been brought. The distance of the nearest native beds of quartz rock would be at Howth, about fifty miles, S.E.; Wicklow, S.E., sixty miles; Donegal, N., ninety miles; Sligo, N.W., ninety miles; Galway, W., 110 miles. Most probably it has been a glacial deposit from Donegal.

E.

Traces of this cairn only sufficient to indicate the site remain; and these show it to have been about five yards in diameter.

F.

About five feet in height of the original cairn still remain. Its diameter is 16½ yards. Clearing away the loose stones and earth which filled the centre showed the arrangement of the interior chambers to be in the form of a cross, the shaft, denoting the passage to the chambers represented by the top and arms of the cross, having a bearing of E. 10° N. The length of the passage is eight feet, and it is two feet two inches broad. The entire length from the commencement of the passage to the extremity of the opposite chamber is fifteen feet, and the breadth from the extremity of the southern to the extremity of the northern chamber is nine feet four inches. The commencement of the passage is not closed up by a block of stone, but merely by small loose stones laid against it. Only one of the roofing flags, covering the commencement of the passage, remains in its original position. Across the entrances of the southern and western chambers are laid stones, about a foot in height, and from four to five inches in thickness. On the floor of the northern crypt rests a rude sepulchral stone basin, three feet five inches long, two feet four inches broad, and five inches thick. Under this basin were found a portion of a bone pin and a flake of flint.

In the south-western corner of the southern chamber, at (*a*),[*] and about a foot from the bottom, was found, imbedded among the clay and stones which filled it up, a brown ironstone ball, three inches in diameter, and well rounded. Several fragments of bones lay scattered indiscriminately here and there upon the floor.

. . . .

At a distance of about two feet outside the circumference stand three pillar stones.

. . . .

Seven of the stones in these chambers are sculptured.

. . . .

G

Is 21 yards in diameter; and is only one yard from F, and 34½ yards from D. Eight large stones stand in the margin. Traces only sufficient to indicate the site of the cairn remain, all the interior chamber stones having disappeared.

H.

The present remains of this cairn are between 5 and 6 feet in height, and 18 yards in diameter; it is 16½ yards from L, the second largest cairn on the western hill. Some curious attempts at dry masonry will be found at the northern and southern extremities of the chambers. The covering of the interior chambers had entirely disappeared, with the exception of about half a dozen large overlapping flags, giving a good example of the mode of roofing, which are still to be seen in their places over the western and northern crypts; and what remained of the loose stones forming the cairn had become entirely overgrown with grass. After carefully clearing out the central chambers, the plan was found to be cruciform, nearly similar to F, except that the central chamber might be considered a rude octagon. The passage, which has a bearing of E. 10° S., is 13 feet long, 2 feet wide at the commencement, and 4 feet wide at the extremity. The entire length from the beginning of the passage to the extremity of the opposite or western chamber is 24 feet; and the distance across the other two chambers, from stones marked 6 to 19,[†] is 16 feet. The breadth of the southern chamber is 2 feet 7 inches; of the western chamber 4 feet at rear, diminishing towards its entrance to 3 feet 2 inches; of the northern chamber, 4 feet 2 inches, on the floor of which rests a rude stone basin, 4 feet 3 inches long, 4 feet broad, and about 6 inches thick. Loose stones and earth filled the chambers and passage for about a foot and a half in depth. The passage itself, from that to the bottom, a depth of about 3 feet, was completely packed with bones in a fragmentary state, nearly all showing evidences of having been burnt, and were found mixed with several small fragments of quartz.

. . . .

From the human remains found in the passage and crypts of this cairn I have collected

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[*] Represented on plan of the chambers accompanying the original paper.

[†] Each stone is numbered on the plans.

150 different pieces of bones;
50 portions of limb bones;
30 other bones—shoulder blades, &c.;
48 portions of skulls;
8 portions of jaws, with teeth remaining;
14 separate teeth.

The three chambers were found filled with an indiscriminate mixture of stones, broken bones, and earth; the latter in a soft, stiff, retentive state, although the weather had been previously very fine. This mixture was picked and removed with great care; and in it were obtained, apparently without having been placed there in any definite order, one end of a bone bodkin; one half of a bone ferrule; six pieces of bone pins;* one tine of an antler, three inches long; fourteen fragments of very rude brown earthenware or pottery, evidently portions of urns, much blackened by fire, particularly on the inside surface; ten pieces of flint; 155 sea shells, in a tolerably perfect state of preservation, and 110 other shells in a broken state; eight varieties of small lustrous or shining stones; 100 white sea pebbles, and sixty others of different shades of colour.

At (*a*) was found a small brown stone ball; and at (*b*) a flake of bone, measuring six by four inches, which appears to have been polished on one side, and may probably have been used as a dish.

Underneath the stone basin in the northern chamber were found imbedded in damp earth, and mixed with small splinters of burnt bones, six stone balls, the largest about an inch in diameter, but in so soft a state, that they could scarcely be touched without injuring them. Five of these appear to be white carbonate of lime, and the other porphyry.

Chiefly in the southern chamber, and about the entrance to it, for the most part imbedded in wet stiff earth, I got the most remarkable collection of bone implements, glass, amber, bronze, and iron, which probably has ever been found together under similar circumstances.

In some few instances where the bone implements chanced to be protected by an overlying stone, their original polish is still perfect; in all other cases they were found in a state as soft as cheese, and could with difficulty be extracted from the stiff earth without breaking them. Such, indeed, was their soft state, that I believe they could not have been preserved for many years longer, and probably many have become entirely decomposed. The shapes of several will be found peculiar and different, and well worth the careful study of the antiquary. Many of them resemble in size and shape the flint knives of Scandinavia. I have been enabled to save 4071 fragments of these in a plain state—once polished, but without further ornamentation: 108, nearly perfect in shape; 60, where the bone material is little decomposed, and still retains the original polish; 27 fragments which appear to have been stained; 11 plain fragments perforated for suspension by a single hole near the end; 501 fragments ornamented with rows of fine transverse lines, and two others similarly ornamented, and perforated near the end; 13 combs, seven of which are engraved on both sides, the heads only and the roots of the teeth of the combs now remaining; 91 implements engraved by compass, and in a very high order of art, with circles, curves, ornamental puncturings, &c., &c., and twelve of these decorated on both sides. On one, in cross-hatch lines, is the representation of an antlered stag, being the only attempt in the collection to depict any living thing. In some instances the perforations near the end appear to have been countersunk.[*] In all there are 4884 pieces. Of the earth which adhered to them I have preserved a package, which it might be very desirable to submit to analyzation.

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* One ornamented bone pin, an inch and three-quarters in length, still retains the metallic rivet which fastened on a head.

. . . .

Of amber, I have collected seven small beads, the largest scarcely a quarter of an inch in diameter, and another small oblong bead of uncertain material.

Of glass, I obtained three small beads of different shapes, and different shades of colour; two fragments of glass, a curious molten drop, one inch long, trumpet-shaped at one end, and tapering towards the other extremity.

Of bronze, I found six rings, slightly open, or rather not closed or cemented into one solid piece, varying from a quarter to three-quarters of an inch in diameter; a portion of another, which is hollow, and formed by overlapping a thin plate of bronze; portions of eight other small rings, in a less perfect state.

Of iron, I found, not lying together, but mixed up with the earth and *debris* which filled the southern chamber, in all seven specimens, each of which, as might be expected, is thickly coated with rust. One is an open ring, about half an inch in diameter; one half of another, somewhat larger; two pieces, each about an inch long, and a quarter of an inch thick, of uncertain use; one thin piece, probably a portion of a knife or of a saw, three-quarters of an inch long, and half an inch broad; one piece, an inch and a half long, which, I think, presents all the appearance of having been one leg of a compass, with which the bone implements may have been inscribed; and, lastly, an iron punch, or pick, five inches long, with chisel-shaped point, and head that bears evidences of the use of the mallet. The circular symbols, and the greater part of the other figures found upon the sculptured stones, have all been punched or picked out, and afford every appearance of having been executed with such a tool as this.[†]

In this cairn there are five inscribed stones.

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[*] Our learned President has kindly undertaken to describe these ornamented bone implements.

[†] This cairn may have been the tomb of some early queen, the beads found being probably portions of a necklace; and several of the bone implements, the forms and uses of which

I.

This cairn is 64½ yards to the east of F, 53 yards S. W. of L, and is 21 yards in diameter. The apex of the cairn itself has disappeared, leaving from four to five feet only in height of the original structure, wanting the slabs by which the interior chambers had been covered. These crypts had become filled up with small stones, by the removal of the roof. Directly over the chambers a thick crop of luxuriant nettles flourished, and struck their roots down into the interstices of some of the laminated flagstones forming the chambers. During the progress of clearing out the interior, I had thus the mortification of seeing portions of some of the engraved stones crumble down, forced out by these nettle roots, before I was able to make any record of the devices on them. The direction of the entrance is due east. The passage alone is eight feet six inches long, and four feet six inches wide; and the distance from the commencement of the passage to the back of the opposite chamber is twenty-two feet; the diameter across the chambers north and south measures thirteen feet. The interior arrangement consists of seven compartments, marked *a*, *b*, *c*, *d*, *e*, *f*, and *g*, formed by flagstones standing out towards the centre of the structure. The breadth of *a* is two feet eight inches; of *b*, three feet six inches; of *c*, three feet seven inches; of *d*, three feet eight inches; of *e*, three feet seven inches at rear, narrowing considerably towards the entrance; of *f*, three feet ten inches; of *g*, two feet eight inches.

On each of the floors of *a*, *b*, *d*, and *e*, rested a square flag, about two square feet in area, and two inches thick. A quantity of charred bones was found on each of these flags; but in such a crushed state, from the falling in of the stones upon them, that it would be difficult to determine to what portion of the frame they belonged. On lifting up the flag on which the bones had been placed in each of these four compartments, I found immediately underneath, a layer, about four inches in depth, of dry small stones, the surface portion of the layer broken very fine, from a quarter of an inch to an inch in size, and having some fragments of charred bones scattered on top, the lower portion of the layer consisting of larger stones.

In compartment *a*, which exactly faces the east, and on the surface of these finely broken stones, I found two stone ornaments—a bead and a pendant. The bead lay about the centre of the space, covered by the flag; and the pendant under, but close to the extremity of the flag, on the right hand side, and near the back of the compartment. The bead has been highly polished, and its being narrower on one side than on the other will show that it was intended to be worn in a circular form. I conjecture that both are portions of a necklace, such as has been found in 1864 by M. L. Galles in the tumulus of Tumiac, in Morbihan. The greatest diameter of the bead is three-quarters of an inch;

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are now a puzzle, may have been instruments of female industry, perhaps for weaving, &c., used in remote times.

and the pendant, perforated by a single hole for suspension, is one inch and a quarter long. Both appear to have suffered from the action of fire; and have become so decomposed, that it is somewhat hazardous to name the materials of which they are formed. The bead, however, *resembles* pale gray earthy grit, which has become soft from the decomposition of the felspathic part of the stone, or more probably is blue carboniferous limestone; and the pendant *yellow shale*, mixed with whitish particles.

The floor of compartment *f* was covered with a closely fitting flag, three feet ten inches long, three feet three inches broad, and nine inches thick. I found no bones resting on its surface, as I had done on the other floor flags in the other compartments furnished with a slab; but, on raising it, I observed that it covered a layer of finely broken stones, mixed with splinters of charred bones, and having a depression of nearly a couple of inches in the centre. This stone, as it rested on the floor, concealed the sculpturing on the lower portion of the stone numbered fourteen, to a height of twenty-two inches from its base.

Nine of the stones in this cairn are inscribed.

. . . .

J.

This cairn is twenty-three yards N. E. of H, and only three yards distant from L. It is 15½ yards in diameter, and its present remains, from four to five feet in height, with twelve large stones still in the circumference. The interior had been much disturbed, but left filled up with loose stones and rubbish. The passage, having a bearing of E. 10° S., is seven feet six inches in length, without any upright stone closing its entrance. A roughly-finished brown stone ball, about an inch in diameter, was found near the opening of the passage into the interior chambers.

Three of the stones in this cairn are inscribed.

. . . .

K

Is 12½ yards N. E. from L, and is 16½ yards in diameter. When the interior was cleared out, the large flagstones forming the central chambers were found in a rather disorderly condition. The bearing of the entrance is E. 15° N. Thirteen stones remain round the margin, and no object of antiquarian interest was found here. At a distance of twenty feet to the south-east now lies a pillar stone, six feet long, two feet broad, and one foot thick.

Two of the chamber stones are inscribed.

. . . .

L

Is 45 yards in diameter, surrounded by 42 large stones, laid lengthwise on their edges, and varying from six to twelve feet in length, and from four to five feet high. Great quantities of the loose stones which formed the apex of this cairn have been removed, of which there are very visible evidences. A curve inwards in the circumference, of ten yards in length, on each side of a point having a bearing of E. 20° S., indicates the direction of the entrance or passage, which commences at a distance of eighteen feet inward from the circumference."

Finding a large flag on the top of the mutilated cairn, I removed it and two others before I observed that I was actually taking to pieces what remained of the original construction of the roof. The principal portion of the overlapping flags which formed the roof over the chambers had disappeared, leaving them filled up with the loose stones which had fallen in. When the chambers were carefully cleared of these small stones, they exhibited *in situ* about forty of the large plinths which formed the matchless, dry, Cyclopean masonry of the roof. This dome was constructed of large slabs, overlapping one another, and bevelled slightly upwards, having most ingeniously inserted between them thinner slabs, which, on receiving the superincumbent weight, became crushed, and formed a bond for the whole. Wherever this precaution of placing thinner slabs or smaller stones between the larger ones was omitted, the larger slabs themselves are now found cracked across. What at present remains of this unique roofing rises twelve feet above the level of the floor, which is even with the ordinary surface of the ground. The breadth of the passage at the commencement is 1 foot 10 inches, which increases to upwards of 3 feet about the middle, and contracts again to 1 foot 9 inches, where it terminates. The passage itself is 12 feet long; and the entire length, from the commencement of the passage to the extremity of the western chamber, is 29 feet. The greatest breadth across the chambers is 13 feet 2 inches; measured from stones, 8 to 21, and from 6 to 24, the distance is 10 feet 4 inches.

Cist (*a*) is 4 feet 8 inches in breadth.
" (*b*) " 3 " 6 " "
" (*c*) " 2 " 2 " "
" (*d*) " 4 " 3 " "
" (*e*) " 3 " 5 " "
" (*f*) " 2 " 6 " "

From among the loose stones which filled up the chamber, I collected 1010 portions of bones; two pieces of bone apparently silicified, a spear point in bone, and portion of a polished bone javelin; 154 fragments of very rude pottery, having the appearance of being only sun-dried, but which is really owing to the imperfect method of firing, and varying in size from 1 to 30 square inches. Some fragments retain their original brown colour, but the generality of them are much blackened by fire on the inside surface, and for a distance round the exterior of the lip, or upper rim of the urns, of which they were parts. One piece, a portion of the upper edge of an urn, about 3 inches long, and 3 broad, is very rudely ornamented with three slight ridges; and, about an inch from the top, is perforated by a single hole. Another larger piece, ornamented with four slightly raised ridges, is perforated by two holes, one an inch and a half below the other.

. . . .

Bateman, in his "Ten Years' Diggings," mentions urns with similar perforations, which he supposes were for suspension, and which he classes as incense urns; but I believe the specimens now found are new in this country—at least, I have not seen nor have I heard of any such having been found in Ireland before this date.*

Extending along the floor of the passage, completely covering it, and inclining a little way into the space surrounded by the interior chambers, seven in number, lies a flag 8 feet 9 inches long, 3 feet 6 inches broad, and about 6 inches thick. Close around the western end of this stone the earth on the floor, to a depth of about 2 inches, was perfectly black, arising, it appeared to me, from the presence of blackened ashes; from which it may probably be inferred that the process of cremation was performed on this stone.

On the floor of the chamber formed by stones marked 7 and 9, and shut in by an upright stone of a foot high and 4 inches thick, rested a quadrangular stone basin, hollowed out from the sides towards the centre, to a depth of 3¼ inches, and having a piece taken out of one of its sides. It measures 2 feet 11 inches in length, by 2 feet broad, and is about 6 inches in thickness. Mixed with the earth under this sepulchral basin were found many fragments of charred bones and several human teeth.

Completely filling up the length of the opposite chamber, entered through a space only two feet wide between two upright stone pillars, rests an oval-shaped stone dish or basin, probably the largest yet discovered in a cairn. The broader end points to the east, the narrower to the west. Its greatest length is 5 feet 9 inches; at a distance of 18 inches from the narrower extremity it is 3 feet 1 inch broad, and at 18 inches from the other extremity it is 7 inches broader, where, on the side facing the chambers, a curve of about four inches broad has been scooped out of the side of the stone. A raised rim running all round it, varies from two to four inches in breadth, rising about an inch above the otherwise perfectly level surface of the stone. The exquianother stone ball, upwards of three-quarters of an inch in diameter, of a brown colour, dashed with dark spots; a finely polished oval jet ornament, an inch and a quarter in length, and three-quarters of an inch broad; eight other white stone balls, probably carbonate of lime, which, from lying for ages in their damp bed, had become quite soft, but which gradually dried, on exposure, to a sufficient degree of hardness to enable me to take them away in a tolerable state of preservation.

I should perhaps have previously observed that the large flagstones alluded to in this paper are, as to material, of a uniform character, consisting of compact sandy grit, the natural rock of the locality. The stone, however, marked No. 18 in this cairn, is an exception, being a good specimen of a water-washed column of blue limestone, probably from some of the adjoining lakes; and the stone marked No. 2, in cairn W., is a similar stone.

It is also worthy of remark that the stone No. 25 in this cairn—for which there does not appear to be any particular necessity in the construction of the chamber, there being already a stone placed there to form the back—is a diamond-shaped slab, placed on one of its angles; and the stone abutting on it is elaborately carved on both sides with diamond-shaped figures. A Celtic drinking cup, with handle, was discovered by Mr. Bateman in 1850, in a cairn about a mile north of Pickering,* which was found to be decorated with this same diamond-shaped pattern. Of it he says:—"The ornamentation of the vessel is peculiar, consisting chiefly of angularly pointed cartouches, filled with a reticulated pattern, and having a band of the same encircling the upper part."

. . . .

On the lower surface of the second large roofing flag, above the upright, numbered 21 (having two layers of thin stones intervening), and looking directly down upon the large sepulchral basin, is a reticulated pattern, finely cut, nine inches long, and varying from three to four inches in breadth, formed by twelve short lines crossing in a slanting direction eight other nearly parallel lines, having at present about fifty meshes, varying from half an inch to an inch in breadth, and from an inch to an inch and a half in length.

. . . .

M.

About 650 yards to the S. E. of L, and crowning the next knoll, called Carrickbrac, from the speckled nature of the rock which forms the hill, are the remains of a cairn, 22 yards in diameter, at present only about four feet high, and wanting the usual boundary ring of large stones.

N.

On the top of a second knoll, 572 yards due east from M, are the *debris* of a cairn, 22 yards in diameter. At present not more than two feet in height of the small stones which composed it remain. Four large stones outside this cairn mark an avenue, pointing due east, of 16 yards long, 7 yards wide at the entrance, and diminishing to 4 yards wide as it approaches the cairn. One stone stands upwards of six feet above the surface.

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* See Bateman's "Ten Years' Diggings," p. 209.

O.

In the valley below the two knolls, 352 yards N. E. from M, and 279 yards N. W. from N, are the remains of a cairn, 11 yards in diameter. Three large prostrate stones, each measuring about 4 × 3 feet, mark the site. One upright stone, 3 feet 9 inches high, 3 feet 9 inches broad, and about 1 foot thick, is still standing, apparently in the circumference of the original cairn. On its western face, arranged principally in four groups, are 28 cups, varying from a half to three quarters of an inch in diameter, and about a quarter of an inch deep. Probably these may have been intended to represent some of the constellations.

P^1.

143 yards N. E. from N. are the remains of a cairn, eight yards in diameter. Sufficient stones only remain to denote the original basis of the cairn.

P^2.

About 22 yards northwards are six large stones, probably the remains of another cairn. One of these stones, 6 feet 6 inches long, 5 feet 6 inches broad, and about 2 feet thick, rests at present in an inclining position, and has its eastern face thickly covered with small cup-like hollows; but, as these may possibly have been created by the action of rain water, I do not think it right to take further notice of them.

Q.

Thirty-eight yards northward from P^2 are the remains of another cairn, four and a half yards in diameter. Nearly all the stones which composed it have been carried away.

R^1.

Passing up the hill in an easterly direction, and at a distance of 242 yards from Q, we come to the remains of a cairn, eleven yards in diameter. All that now remains of the original pile varies from two to three feet in height.

R^2.

Sixteen yards to the south of R^1, and fifty-five yards S. W. from T, are the remains of another cairn, nine yards in diameter, and about two feet in height. Ten of the stones forming its circular boundary still remain; and outside the cairn, at a distance of from three to four yards, lie five large stones.

S

Is only five yards to the west of T, and fifty-one yards from R¹. Thirty-three large stones standing on ends form a circle, 18½ yards in diameter, round the present remains. The apex of this cairn is completely gone, leaving exposed the tops of the upright stones forming the chambers, the arrangement of which here differs from the others in having the passage or entrance from the west—exact bearing W. 10° N. The entire length of the passage and chambers taken together is fifteen feet. The passage itself, which varies in breadth from two feet three inches to two feet seven inches, is divided by transverse upright stones into two compartments, each about two feet square. Outside the entrance of the passage, at the spot marked (*c*), was found a perfect specimen of a white flint arrow head, an inch and a half long, and nearly three quarters of an inch broad. Compartments (*a* and *b*) in the passage were filled up to the height of eighteen inches with charred bones, broken into small fragments, on the top of which, in chamber (*a*), was found a rude bone dagger, seven inches long, and nearly an inch broad; and in a similar position, in chamber (*b*), a piece of bone, nine inches long, tooled and rounded at one end, apparently a portion of a bow, and now silicified. Nearly covering the floor of each compartment (*a* and *b*) rested a thin flag, underneath which were found splinters of burned bones, intermixed with small stones and pieces of charcoal.

. . . .

Six of the chamber stones here are inscribed.

T.

In the distance this is the most conspicuous of all the cairns, crowning the summit of the highest of all the peaks in the range, that one especially known as Sliabh-na-Caillighe. The original shape of the cairn is still very perfect, having an elevation of twenty-one paces in slant height from base to summit. It is 38½ yards in diameter, and is inclosed by a circle of thirty-seven stones laid on edge, and varying in length from six to twelve feet. Exactly facing the north, and set about four feet inwards from the circumference of the cairn, is a large stone, popularly called "The Hag's Chair."* It is about ten tons in weight, measuring ten feet long, six feet high, and two feet thick, and has a rude seat hollowed out of the centre. The ends are elevated nine inches above the seat, and the back has fallen away by a natural fracture of the stone. The cross carved upon the seat of this chair, as well as others which will be found on the upright marginal stones here and in cairn S, were cut for trigonometrical purposes by the men formerly engaged in the triangulation survey of the country. Underneath the seat the stone appears to have been rounded off, or beaded, for ornament, for nearly its entire breadth, below which are a considerable number of small cup hollows, which I did not enumerate, as they have become much defaced by the action of time and the weather. Further down on the face of the stone will be found a double zigzag, nine inches long; a figure consisting of six concentric arches, seven inches high, and seven inches broad; three concentric circles, seven inches across; a cup surrounded by three concentric circles, six inches across. On that portion of the original back of the chair which has not fallen away will be found a cup with two concentric circles, four inches across; and in another place, two separate cups. In front of, and round the base of the chair, considerable quantities of quartz, broken into small lumps, were strewn about.

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* The ornamentation and inscriptions on this megalithic seat point to its having been formerly used for some important purpose. Probably it has been a coronation or inauguration chair; or, perhaps, a seat round which councils have been held, or from which justice has been administered in far distant ages.

On the eastern side, the stones forming the periphery of the cairn curve inwards for eight or nine yards on each side of a point where the passage to the interior chambers commences, on the very margin of the cairn, the bearing of the passage being E. 10° S. The entrance to the passage was closed by two irregular blocks of stone, inside of which were dropped three other large blocks of stone, filling up the passage for five or six feet in length. On the outside of the entrance was placed a loose layer of lumps of quartz. All the roofing flags covering the passage, and more than two-thirds of what originally covered in the central octagonal chamber, had disappeared, leaving the passage and central chambers completely filled up with stones. Among the loose stones over the central octagonal chamber were found three large bones, probably belonging to a deer. The imperfect portion of the roof that remains, formed by about thirty large flags overlapping one another, rises to ten feet above the level of the floor. The floor of the central octagonal chamber was covered by two large, and three small flags. The largest I have not been able to raise; but underneath the others were found fragments of charred bones, small broken stones, and pieces of charcoal. The three cists (*a*, *b*, and *c*) are each about four feet square. Above the upright stones forming the walls of each chamber about half a dozen large flags, overlapping one another, are covered in by a horizon-

The entire length of the passage is seventeen feet; and from the commencement of the passage to the western extremity of the opposite chamber, is twenty-eight feet. The distance from the back of cist (*a*) to that of cist (*c*) is sixteen feet four inches, while the distance between their entrances is seven feet; and from the termination of the passage to the entrance of cist (*b*), is six feet three inches. The breadth of the passage at its termination is three feet one inch; of cist (*a*), two feet eight inches; of cist (*b*), three feet five inches; of cist (*c*), three feet six inches.

There are twenty-eight inscribed stones in this cairn.

. . . .

Chamber (*b*) has a beehive roof of seven flags, capped by a large horizontal one, on which is a figure formed of fourteen concentric circles—as far as they can be counted—extending out of sight under the structure, where no tool could reach; one single circle, two inches in diameter; four cups, each surrounded by a single circle; two cups, each surrounded by two circles; a figure of two concentric circles; another of three concentric circles round a cup; a quadrilateral figure with four lines across; a group of five waving lines, adjoining which are six concentric circles; a straight line, running under the roof, with eight short lines, as far as they can be counted, on each side of it; eight lines in the form of a star, three inches in diameter; five concentric ovals, running under the roof; a straight line surmounted by three elliptical arcs; a circle surrounded by ten rays, making a figure six inches across; a star of six rays; a cup with eight rays, surrounded by a circle six inches in diameter; a cup and circle, out of which rise eleven looped or arched rays, making a figure six inches in diameter; a spiral of four curves, twelve inches in length, having seven lines on each side at right angles to the two outer coils.

. . . .

Chamber (*c*) has a beehive roof, formed by five flags covered in by a horizontal one, on which are cut *in fine lining* less than a quarter of an inch asunder four chevron zigzag lines, about one foot in length, and terminated at one extremity by a single zigzag line at right angles to these; a circle an inch and a half in diameter.

. . . .

On the lintel stone over the entrance to the southern chamber are twelve short lines along the edge of the stone, and six others further down, which probably are Ogham characters.

U

Is situated fourteen yards N. E. from T, and forty-six yards east of S. There are sixteen large stones still in the base; and nearly two feet inside the circumference, a stone, measuring eight feet two inches long, two feet four inches broad, and one foot eight inches thick, lies opposite the commencement of the passage. The present remains are only from four to five feet high, and fourteen and a half yards in diameter.

The tops of the upright stones were left visible, and the chambers themselves more than half filled up with loose stones and earth. On removing these, the interior arrangement of the chambers was found, as in most other cases, to be cruciform. The length of the passage alone, which has a bearing of E. 20° S., is nine feet; and from the commencement of the passage to the extremity of the opposite chamber is twenty feet; while the breadth across the chambers is ten feet. One of the chamber stones is wanting, and another is displaced. When the stones which filled up these chambers were removed, the earth at the bottom, in some places from twelve to eighteen inches in depth, was found to be thickly mixed with splinters of burned bones.

I was informed by an old herd on the mountain that he recollected the chambers in this cairn, in their half-cleared-out state, to have been used for culinary purposes by the men of the Ordnance Survey, when encamped on Sliabh-na-Caillighe many years ago.

. . . .

There are thirteen inscribed stones in this cairn.

. . . .

There are some appearances of a cairn having stood about midway between U and V.

V

Is thirty-nine yards south-east from T, fifty-one yards south of U, and is eleven yards in diameter. All the smaller stones which originally formed the cairn have been carried away, leaving quite bare the upright stones which formed the interior chambers. From present appearances these do not seem to have been arranged on any particular plan. The greatest length of the chambers, having a bearing of E. 20° S., is twenty-one feet, and breadth ten feet. About a yard outside the circumference, on the north-western side, stands an upright pillar stone, five feet above ground, five feet six inches broad, and one foot six inches thick. Digging round the base of this stone, in a fruitless search for engravings, I turned up a long, rounded, white sea pebble, which, from appearances, may have been used as a sling stone or a hammer.

. . . .

Four of the upright stones in this cairn are inscribed.

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W

Is 128 yards east of T. Its present remains appear nearly level with the ground, and are seven yards in diameter. The single interior chamber which this cairn contained is round, or well-shaped; and, unlike all the others, which appear to have been erected on the bare surface of the ground, the earth seems to have been dug away for the construction of this chamber, six feet nine inches in diameter, formed by eight flagstones placed on ends, fitting closely together, except in two instances, and all having an inclination inwards at the bottom. A layer of charred bones, six inches in thickness, was found to cover the bottom of this chamber; in the clearing out of which was brought to light, resting on the floor, a splendid stone urn, two and a half feet square, one foot thick, and hollowed out from the sides towards the centre to a depth varying from three to four inches. On raising this urn, which evidently occupied its original position, some splinters of charred bones were found beneath it. The point which appears to have been the entrance to this chamber has a bearing due south.

. . . .

Five of the chamber stones in this cairn are inscribed.

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X.

Passing from the hill specially known as Sliabh-na-Caillighe, and midway up the next or eastern peak, called the Hill of Patrickstown, are found together the remains of three stone circles. These are marked in the recently executed Ordnance Map as "carns;" but it is doubtful whether they are the boundary rings of large stones usually encircling cairns, or merely simple stone circles. The northern circle is the most perfect of the three, the other two being in their present state little more than semicircles.

The diameter of the northern circle is forty feet. The distance from stone No. 1 to No. 2 is four yards; from 2 to 3, four yards; from 3 to 4, one yard; 4 and 5 nearly touch one another; distance from 5 to 6, two yards; 6 and 7 nearly touch one another; distance from 7 to 8, three yards; from 8 to 9 eight yards; and from 9 to 10, seven yards.

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Thirteen feet inwards from the circumference of the northern circle stands an upright stone, marked on the plan No. 10, upon the face of which, pointing N. W., are inscribed a circle three inches in diameter, a cup with thirteen rays, surrounded by a circle six inches in diameter, on which circle is another cup two inches in diameter, and half an inch deep, from which fall down nine rays, varying from four to twelve inches in length, and from half an inch to an inch in breadth, five of which terminate in a cup; a cup with nine rays, six inches across, over which are thirteen equidistant arcs of circles, varying in length from two to twelve inches; along the lower part of the face of the stone are three circles, one three, one four, and one five inches in diameter.

The designs on this stone can be only seen to advantage in a suitable shade of sunlight. In this I was most fortunate, a little before sunset of an evening in the beginning of this month, February, 1866.

The middle circle is nine yards south of the northern circle, and is twelve yards in diameter. The distance from stone No. 1 to No. 2 is four yards; from 2 to 3, one yard; from 3 to 4, two yards; from 4 to

5, two yards; from 5 to 6, three yards. In the centre of the circle are lying flat two stones, numbered on the plan 7 and 8. No. 5 is inscribed with a cup, having ten others in a circle round it; the circle measuring ten inches across, and having four other cups in an incomplete circle round this again, nearly eighteen inches across, the cups being about an inch and a half in diameter and a quarter of an inch deep; there are also 28 similar cups in one group on this stone.

No. 8 contains a circular hole, six and a half inches in diameter, cut vertically, with much precision and smoothness, to a depth of three inches. For what use this may have been intended it would be difficult to conjecture, if we do not suppose that the stone itself has been unfinished, or not completely pierced through; such as is described by Carro (pp. 47 and 48, Paris, 1863), and again by Le Baron A. de Bonstetten (pp. 15 and 16, Geneva, 1865), as a rare instance occurring in cromleacs or dolmens in Palestine and in India, and especially in that of Trie-le-Château, near Gisors, in France, destined for giving access for fresh sepultures without removing any of the stones, and through a space not sufficient to admit a human body.

The third, or southern circle, twelve yards south of the middle one, and twenty-three yards in diameter, at present contains only seven stones, with an eighth lying five yards west of its boundary. The distance from No. 1 to No. 2 is seven yards; from 2 to 3, fifteen yards; from 3 to 4, four yards; from 4 to 5, nine yards; and Nos. 5, 6, and 7 adjoin one another.

Y.

Crowning the top of the Hill of Patrickstown, which attains the height of 885 feet, there stood until within the past few years one of the most conspicuous cairns in the range Its diameter is thirty-three yards; but only a few cartloads of the stones which formed it now remain, the rest having been used up by Mr. Edward Rotheram of Crossdrum, the proprietor of the hill, in the construction of adjoining fences.*

Z.

At the base of the eastern peak, on the south side, stands the Moat of Patrickstown. It measures 115 paces round the base, 45 feet in slant height, and 40 paces round the circumference at the top, which is flattened. This tumulus is situated on the top of a small sloping eminence in a green field, and is crowned by a mutilated whitethorn tree, growing on its eastern border. It is covered with earth and grass, but is said to contain stone chambers in the interior.

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* Nearly four hundred yards east of this cairn are the remains of a burying place, measuring 16 × 14 yards in extent, and raised three or four feet higher than the adjoining ground. Early in the sixteenth century a regular battle was fought on this hill between two neighbouring septs—the Plunkets and the O'Reillys; and it is said that the dead of both parties who remained on the field after the battle were interred here. The inclosure contains an upright stone—possibly the shaft of a rude cross—measuring seven feet in height, one foot six inches broad, and eight inches thick.

Although the carved stones, previously referred to, exceed one hundred in number, there are not two the decorations on which are similar. On the stones which have been long exposed to the destructive effects of the atmosphere, the punched, or other work, is often much obliterated; but on those lately exposed, the work of the tool is almost as fresh and as distinct as at the period of its execution.

At what remote, or even recent period, these ancient tombs have been subjected to demolition, it would be difficult to determine. I have heard, however, from old men who were engaged at the work of exploration, that they recollected, before quarries were generally opened in the country, that persons were in the habit of coming from distances of twenty or thirty miles round about, to procure from these archaic structures slabs suitable for domestic or other purposes. Of what now remains, deprived of most of the roofing flags, the inscriptions* on the sculptured chamber stones in thirteen chambers, on the entire range, may be thus summarized:—

406 single cup-like hollows, some arranged in parallel lines, some in circles, and many of them scattered in groups, probably intended to represent constellations; 86 cups, each surrounded by a single circle; 30, by two circles; 17, by three circles; 4, by four circles; 3, by five circles; 4 cup hollows, each surrounded by a spiral; 35 star-shaped figures, varying from four to thirteen rays in each; 22 circles, with rays emanating from each; 14 cups, each surrounded by a circle with rays emanating from it; 16 single ovals; 1 figure of two concentric ovals; 1 of six; 114 single circles; 32 figures of two concentric circles; 10 of three; 6 of four; 4 of five; 1 of six; 68 semi-elliptical or arched figures; 12 spirals, 14 quadrilateral figures, 6 triangular figures, formed by cross-hatched lines; 54 reticulated figures, consisting in all of 138 diamonds; nearly 300 single straight lines, some of which may probably be Oghamic; upwards of 80 zigzag, or chevron lines; 10 single curves; 11 figures of two concentric curves, 10 of three, 8 of four, 4 of five, 4 of six, 2 of seven, 1 of eight, 1 of nine, and 2 of thirteen concentric curves. In all—so far as the explorations have gone—I have laid bare 1393 separate devices, which will be found to be many times more than had been previously supposed to exist in Ireland.

From the existence of other sepulchral remains, cairns, moats, &c.,

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* In the original paper the devices on each stone are separately given in detail, as well as plans of the interior arrangement of each cairn, and accurate measurements of the height, breadth, and thickness of each of the stones forming the chambers.

extending from Sliabh-na-Caillighe, in the direction of the town of Kells, and continued thence towards Slane and Drogheda, I have little doubt that the cairns on the Loughcrew Hills are but a portion of a chain of such remains, terminated on the east by the great mounds of Knowth, New Grange, and Dowth; and that a fuller and more careful examination of the country will prove that chain to have extended westward to the Atlantic.

Would it not be interesting to have all the tumuli in the neighbourhood of New Grange thoroughly explored and examined as those at Loughcrew have been, several of them being yet unopened? Their examination would probably afford, if nothing else, a considerable addition to our present knowledge of existing inscribed stone monuments.

I have a strong impression that a further investigation of cairns L and T on Sliabh-na-Caillighe will bring to light additional interior chambers in these two cairns; but, leaving this out of consideration for the present, it will be readily seen that what I have already discovered, and endeavoured here to describe, far exceeds in extent all the carved megalithic chambers which were previously known to exist in the kingdom, and these principally at Dowth and New Grange.

During the progress of the work of exploration at Loughcrew, I furnished myself with paper sufficient to take rubbings of all the inscribed stones, some of which I actually rubbed; but, finding that in several instances accurate rubbings could not be taken at all, and that in addition I could not devote the time necessary for executing a series of more than 100 inscribed faces with due care and accuracy, in this dilemma I urged upon my friend Mr. Du Noyer, who was then living in the neighbouring town of Kells, to employ his ready pencil in drawing the devices on the carved stones. After I left the hills, he completed this great work; and I am sure the Academy will agree with me, that so important a task could not be intrusted to an abler antiquarian artist.

In concluding this first part of my examination of these cairns, which I have confined entirely to descriptive and statistical details, I beg leave to make the following recommendations to the Academy:—

I. That the thanks of this Academy be voted to Mr. Naper and to Mr. Hamilton for the willing, earnest, and important aid which they afforded during the progress of these discoveries; and for Mr Naper's patriotic generosity in allowing me to present everything found to this Academy, where objects of antiquarian interest can be best studied and elucidated.

II. That a separate case in the Museum be appropriated to the safe keeping of the various articles found, with a suitable inscription, recording the aid which Mr. Naper gave in opening up and bringing to light these interesting remains of a pre-historic age in this country.

III. That it would be all-important that the particulars of a find so peculiarly national should be published BY THIS ACADEMY, *with full* *illustrations*, rather than allow its publication to appear in any other form, or in any other place.[*]

IV. That the Committee of Antiquities should obtain from the most competent persons:—

1. An analysis of the earth in which the carved bone flakes, iron, bronze, glass, amber, &c., were found;

2. A descriptive report on the classification of the sea shells;

3. A similar report on the sea pebbles;

4. An analytic report on the human aand other bones, and the various positions and places in which they were found;

5. A report on the apparent anachronisms in the admixture of the stone, bronze, iron, glass, amber, &c., found in cairn H; and that these reports be given to me for insertion in my next and concluding paper on the examination of these ancient remains; and,

6. That some competent person be directed to make search for historical allusion to these ancient tombs, as it is not probable that so remarkable a place could have escaped all notice in the bardic annals of the country.

The Very Rev. the President exhibited and described, and made some observations upon, the ornamented bone articles found in the cairns on the Loughcrew Hills, and placed in his hands by Mr. Conwell.

The marked thanks of the Academy were returned to J. W. L. Naper, Esq., of Loughcrew, for the liberality, earnestness, and zeal which he evinced in furthering the researches of Mr. Conwell, and for his consideration in presenting to the Museum of the Academy the large and varied amount of antiquarian remains which were obtained in the process of excavation of the Cairns on the Loughcrew Hills; as also to Charles Hamilton, Esq., for his kind and valuable services in giving effect to the measures adopted upon the occasion.

Mr. George V. Du Noyer, exhibited a large collection of Drawings made by him of the Antiquarian Remains discovered and explored on the Loughcrew Hills.

The thanks of the Academy were returned to Mr. Du Noyer.

The Secretary, on the part of the Editor, presented the "Register of the King and Queen's College of Physicians in Ireland for 1866."

The thanks of the Academy were voted to the donor.

The Rev. Samuel Haughton, M. D., read his second paper "On the Semidiurnal Tides of the Coasts of Ireland—Castletownsend."

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[*] As the funds placed at the disposal of the Council of the Royal Irish Academy are inadequate to meet the cost of publishing, with suitable illustrations, the very extensive collection of symbols or mystic characters contained on the inscribed stones on the Loughcrew hills, I have only to regret my own personal inability to supply the defect. It is, however, to be hoped that at some future and not distant day funds will be available, either from public or from private sources, for illustrating fully (in which consists the chief value of such discoveries) these comprehensive and most important additions to our archaic literature.

FRIDAY, MARCH 16, 1866.—STATED MEETING.

The VERY REV. CHARLES GRAVES, D. D., President, in the Chair.

The Rev. Dr. CARSON, in the unavoidable absence of the Secretary of Council, read the following

REPORT OF THE COUNCIL.

SINCE our last Report was submitted to the Academy the following Papers in our "Transactions" have been printed, and issued to our members, viz.:—

In the department of Science:—

1. "On the Semi-diurnal Tides of Cahirciveen," by the Rev. Samuel Haughton, M. D.
2. "On the Granites of the County of Donegal," by the same author.
3. "On the Proof of Sir Isaac Newton's Rule for the Discovery of Imaginary Roots in Algebraic Equations," by Professor J. J. Sylvester.

In the Department of Polite Literature:—

1. "On the Assyrio-Babylonian Measures of Time," by the Rev. T. Hincks, D. D.
2. "On the Various Years and Months in Use among the Egyptians," by the same author.

In the Department of Antiquities:—

1. "On Cairns, Cromlechs, Kistvaens, and other Celtic, Druidical, or Scythian Monuments in the Dekhan," by Colonel Meadows Taylor.
2. "On Ancient Cairns on Twizell Moor in Northumberland," by the same author.
3. "Concluding Memoir on MS. Mapped and other Townland Surveys in Ireland," by Mr. W. H. Hardinge.
4. "On the Earliest Known MS. Census Returns of the People of Ireland," by the same author.

Of the "Proceedings," two Parts have been published, viz.:—the 1st and 2nd Parts of Vol. IX.; the 3rd Part of the same volume is just ready for issue; and portions of a fourth Part are already in type.

A great number of interesting communications have been brought before the Academy during the past year. We have had papers on Science from the President, the Rev. Professor Haughton, the late Sir W. R. Hamilton, Professor Sylvester, and Mr. W. H. Griffiths, Professor Huxley, and Dr. Perceval Wright; on Polite Literature, from the Rev. Dr. Hincks, Mr. Gilbert, Mr. Joyce, and Mr. Morisy; and on Antiquities, from Mr. Hardinge, Rev. J. Shearman, Mr. W. M. Hennessy, Mr. Conwell, and Mr. Du Noyer.

During the past year some important additions have been made to our Manuscript Collections. From the Very Rev. Charles Vignoles, Dean of Ossory, we have received the valuable original MS. of the "Memoires of Dumont de Bostaquet," an authority frequently cited by Lord Macaulay in his account of the Irish Wars of the Revolution. P. O'Callaghan, LL. D., of Leamington, has presented a highly interesting Collection of Autograph Letters of distinguished persons, and from Mr. D. H. Kelly we have received four folio volumes of MSS. compiled by the late Mr. J. F. Ferguson.

The Academy has been enabled by liberal contributions, chiefly from its members, to secure, at the price of £100, the Manuscript Collections of the late Mr. John Windele, of Cork, extending to 130 volumes, and including many MSS. in the Irish language, Sketches and Descriptions of Munster Monuments, and a large number of Original Letters addressed to him by notable persons in connexion with his researches in Cork and Kerry. We have also placed in our Library a complete copy of the Irish Census Returns ascribed to the year A. D. 1659. This transcript has been carefully prepared and collated under the personal inspection of Mr. W. H. Hardinge, to whom the public are indebted for the discovery of the original documents among the papers of Lord Lansdowne.

We are indebted to the Master of the Rolls in England for thirty-four volumes of the Calendars and Historical Works now appearing under his superintendence. We have also received from the Society of Antiquaries copies of some of their most valuable publications, including the Edition of the "Codex Exoniensis," by Thorpe; and that of Layamon's "Brut," by Sir Frederick Madden.

The late Mr. W. Smith O'Brien, in addition to a valuable Gold Vase, which by his will he directed to be deposited in the Academy's keeping, has bequeathed to us a collection of Books, a Catalogue of which will be printed as an Appendix to this Report.

The Academy's collection of Antiquities continues steadily to increase. During the past year 236 articles found in Ireland, and 155 illustrative specimens from other countries, have been added to the Museum. Of the former 185 were presented, 14 were purchased, and 37 valuable articles were procured under the Treasure Trove Regulations, by which means the funds of the Academy allotted to the Museum have been greatly economized.

The rich collection of Coins and Medals in our possession has not yet been arranged. The Council hope that some of the Numismatists who are Members of the Academy may be induced to undertake the task.

The sale of the first three Parts of the Catalogue still continues; and there is at present in hands a balance to the credit of the account of that work, as also the Woodcuts for the portions relating to the articles of Silver and Iron.

With regard to the state of the Academy's finances, the Treasurer reports that all liabilities have been discharged up to this date, leaving, as far as can be at present ascertained, a balance in the Academy's favour. The Treasurer, however, thinks it right to add, that engagements have been entered into for the illustration of the valuable paper recently communicated by Professor Huxley and Dr. Perceval Wright, as well as for other publications, which will seriously limit the sum to be spent in that department for the ensuing year, unless additional funds can be provided.

At the date of the last Report, we had addressed to the Lords Commissioners of Her Majesty's Treasury a Memorial, praying for an increased public grant to the Academy. This Memorial was founded on the Report of the Select Committee of the House of Commons on the Scientific Institutions of Dublin, in which the strongest testimony had been borne to the value of the work done by the Academy, to the learning and ability displayed in its "Transactions," and to the national importance of its Museum and Library. The result of the Memorial was an addition of £200 to the annual grant provided for in the estimates; this sum being appropriated to the encouragement of the study of ancient Irish manuscripts, by forming catalogues, and procuring translations of them, and making them available for public use. While we gratefully acknowledge this addition to our resources, which will enable us to promote an important and ill-rewarded branch of research, we must at the same time repeat our former statement, that without further assistance from Parliament we cannot accomplish in a really satisfactory manner the objects of our institution. Not only do we find difficulty in printing and illustrating the papers read before the Academy, but the want of an adequate staff prevents our affording to the public such facilities as would be desirable for reading in our Library, and studying the treasures of art and antiquity contained in our Museum.

When the additional grant above mentioned became available in December last, the Council lost no time in taking steps to carry out the objects for which it was made. After careful consideration, they appointed as Irish scribe to the Academy, Mr. Joseph O'Longan, having fully satisfied themselves of his capacity to execute the duties of that post.

Considering that the first and most important step to be taken was the completion of the Descriptive Catalogue of the Academy's Irish MSS., they at once committed this task to Mr. O'Longan, and also secured the valuable services of Professor Owen Connellan.

Progress has already been made in preparing Irish texts for the press, and in continuing the Catalogue of MSS. from the point at which it was left unfinished by the late Professor O'Curry. These works are carried on under the personal inspection of the Librarian, and a special committee of the Council has been appointed for the management of the business of this department.

We have lost by death, within the year, two Honorary Members, viz.:—

1. Sir W. Jackson Hooker, K. H., F. R. S.; elected June 27, 1825;
2. The Rev. William Whewell, D. D., F. R. S., Master of Trinity College, Cambridge; elected January 25, 1836.

And nine Ordinary Members, viz.:—

1. Rev. W. H. Drummond, D. D.; elected November 29, 1817.
2. Right Hon. the Earl of Donoughmore; elected January 11, 1864.
3. Sir W. R. Hamilton, LL. D.; elected October 22, 1827.
4. Edward Hutton, M. D.; elected April 27, 1835.
5. Thomas Hutton, Esq., D. L.; elected February 10, 1840.
6. George A. Kennedy, M. D.; elected November 30, 1835.
7. George Petrie, LL. D.; elected February 25, 1828.
8. Sir Thomas Staples, Bart.; elected June 13, 1842.
9. Right Hon. John Wynne; elected April 10, 1843.

In this list are included two names of European celebrity—names which stand in the foremost ranks of Mathematical Science, and Archæological Learning, respectively. After the able and eloquent tributes lately paid by our President to the memories of Sir William Hamilton and Dr. Petrie, it is unnecessary for us to enlarge on the loss sustained by our country, and by the republic of letters, in the deaths of these distinguished men. But we may be permitted to observe how closely the labours and the renown of both were associated with this institution. Almost all the important researches of Hamilton were published in our "Transactions" or "Proceedings," from the "Essay on Systems of Rays," which first established his reputation, and for which he obtained our Cunningham Medal, to the "Theory of Quaternions," which was the latest product of his genius. The first hints of this Theory were given in communications read before the Academy; and up to the close of his life, he continued to bring before us, from time to time, the newest developments and applications of the method. In like manner, those works on which Dr. Petrie's reputation is principally founded—the treatises on the Round Towers of Ireland, and on Irish Military Architecture—were prize essays written on subjects proposed by the Academy; while for that on the History of Tara one of our Medals was awarded him; and our members do not need to be reminded how often, to the very last, he took part in our discussions, and by his archæological learning and skill threw light on the questions which came before us, and illustrated the objects of Art or Antiquity which were exhibited at our meetings.

Another well-known and much-respected name appears in our Obituary list—that of the Rev. Dr. W. H. Drummond, who was for a long time a member of our Council, and Librarian of the Academy. He was an ardent lover of literature, and possessed much solid learning, as well as general cultivation and refined taste. His mild and amiable nature endeared him to his friends; and when, in 1861, in consequence of his age and increasing infirmity, he retired from the position he had held on our Council, he carried with him the sincere esteem of his colleagues and of all the members of the Academy.

He produced many poetical pieces, which gave evidence of refined taste and elegant culture. The principal of these were:—"Juvenile Poems," written when he was a student of the University of Glasgow; A Translation of the First Book of Lucretius; "The Man of Age, a Poem;" "The Battle of Trafalgar;" "The Giant's Causeway," a descriptive and philosophical poem; "Clontarf, a Descriptive and Historical Poem;" "Bruce's Invasion of Ireland;" "The Pleasures of Benevolence;" and "Ancient Irish Minstrelsy, consisting of Metrical Translations, with Explanatory Notes." He was also editor of the "Autobiography of Archibald Hamilton Rowan," with additions and illustrations, and author of several prose writings on moral and theological subjects.

He contributed the following papers to our "Transactions" or "Proceedings:"—

"Roman Coins in Ireland."—"Proceedings," vol. vii.
"On the 'Exile of Erin.'" Ib., vol. viii.
"On Magnus Barefoot." Ib., vol. v.

"An Essay on the Life and Writings of Oppian" ("Transactions," vol. xiii.); and "An Analysis of the Cynegetics of Oppian" (ibid).

A Prize was awarded to Dr. Drummond, in the year 1828, for an "Essay on the Authenticity of the Poems of Ossian," which is printed in "Transactions," vol. xvi.

The following Ordinary Members have been elected since March 16, 1865:—

1. Rev. B. W. Adams, D. D.
2. Rev. T. D. F. Barry.
3. Richard R. Brash, Esq.
4. Captain Richard F. Burton.
5. Rev. Arthur Bruce Frazer.
6. John Freeland, M. D.
7. G. Hatchell, M. D.
8. William F. DeVisme Kane, Esq.
9. W. Armstrong MacDonnell, Esq.
10. Rev. Silvester Malone.
11. William J. O'Donnavan, LL. D.
12. E. Stamer O'Grady, M. D.
13. Joseph O'Kelly, M. A.
14. D. O'Sullivan, LL. D.
15. Henry Wilson, Esq.
16. Rev. Richard Wrightson, M. A.

ADDITIONS TO MUSEUM OF THE ROYAL IRISH ACADEMY, FROM APRIL 1, 1864, TO MARCH 16, 1865.

DONATIONS.

1. A Collection of Irish Antiquities: presented by Dr. Todd, on behalf of Mrs. Ogilby, of Kilcattan (70).
2. Antiquities and Human Remains found in the county of Down in 1780: presented by the Earl of Granard (8).

3. An early "Noble" of Edward IV.: presented by J. J. Lalor, Esq. (1).
4. Specimen of Ancient Armour, a small gold Fibula, and the remains of a Harp which had been found with them: presented by Dr. Gray, of Drogheda (3).
5. Lenticular portion of the Horn of a Short-horned Ox: presented by E. O'Flaherty, Esq. (1).
6. A yellow Flint Arrow Head: presented by the Rev. P. Langan (1).
7. An 18-lb. Cannon Ball of 1641: presented by Samuel Cleburn, Esq., of Springmount, county of Tipperary.
8. A Stone Miner's Hammer from Killarney: presented by D. H. Kelly, Esq. (1).
9. An Oak Canoe, 42 feet long, found in Lough Owel, county of Westmeath: presented by Charles W. Levinge, Esq. (1).
10. An Old Silver Finger Ring: presented by Charles Davis, M. D. (1).
11. Gutta-percha Impression of Great Seal of Queen Victoria: presented by H. Roche, Esq.

PURCHASES BY THE ACADEMY.

1. A Bronze Celt, from Kilglass (1).
2. Ancient Ring (1).
3. Iron Sword, from Chapelizod (1).
4. Two Great Seals in wax (2).
5. Ancient Brass Seal, from Cistercian Abbey, Baltinglass (1).
6. Ancient Wooden Shield (1).
7. Bronze Pin, from Moyvore, county of Westmeath (1).
8. Two lots of Antiquities, bought at Jones's (48).
9. Antique Candlestick, from Shrule Castle, Tullamore (1).
10. Ten Stone Celts, and one Flint Arrow Head (11).
11. Bronze Beam of Scale, from Kilmainham (1).
12. Wooden Crucifix (1).
13. Small Bronze Ring Pin, from Annagh, county of Westmeath (1).

PURCHASES BY TREASURE-TROVE REGULATIONS.

1. Gold Lunula (1).
2. Ditto (1).
3. Ditto, imperfect (1).
4. Gold Ring (1).
5. Two large Gold Armlets (2).
6. Four Gold plain Fibulæ (4).
7. 58 Amber Beads, 4 Bones, 1 Pipe, 1 Bronze Ring (64).
8. Small Gold Fibula, with ribbed arch (1).
9. Old Coin.

The only deposit made has been that of the Clogh Oir, by Marcus Keane, Esq.

Catalogue of Printed Books bequeathed to the Royal Irish Academy by the late William Smith O'Brien, Esq.

1. Dictionary of the Gaelic Language. 2 vols., 4to. Published by the Highland Society. Edinburgh and London, 1828.
2. Magyarföld és népei eredati Kepekben. (Presented to W. S. O'Brien by Ant. T. Esaky.) 4to. Pesth, 1846.
3. Shakspeare's Works, edited by Barry Cornwall. (Presented by C. Gavan Duffy.) 3 vols., Imp. 8vo. London, 1843.
4. Wallachian Bible, by J. Heliade Radulesio. (Presented by the Editor). Imp. 8vo. Paris, 1858.
5. La Normandie, par M. Jules Janin. Imp. 8vo. Paris (No date).
6. Keating's Ireland, translated by J. O'Mahony. (Presented by the Publisher.) 8vo. New York, 1857.
7. Moore's Poetical Works. (Presented by J. L. Fitzgerald.) 8vo. London, 1848.
8. History of the Island of Scio, by A. M. Blastos. Hermonpolei, 1840.
9. The Turkish Empire, by R. R. Madden. (Presented by the Author.) Vol. I. 8vo. London, 1862.
10. Todd's Life of St. Patrick. 8vo. London, 1864.
11. Gaelic Journal. 8vo. Glasgow, 1830.
12. Lexicon Ciceronianum Marii Nizolii, ex recensione Alexandri Scoti. 3 vols. 8vo. London, 1820.
13. Ciceronis Omnia Opera, ex recensione J. A. Ernesti. 8 vols. 8vo. London, 1819.
14. History of the Greek Insurrection, by Tricoupi. (Presented by L. P. Mavrogordato.) 4 vols. 8vo. London (no date).
15. Willis's Poems. (Presented by W. D. Train.) 8vo. New York, 1848.
16. Report on Authenticity of the Poems of Ossian, by H. Mac Kenzie, Esq. 8vo. Edinburgh, 1805.
17. Macaulay's Lays of Ancient Rome. (Presented by M. F. O'G.) Sm. 4to. London, 1849.
18. A Letter to M. Le Comte de Montalembert, on his late Review of the Government of England, by George H. Moore, Esq. (Presented by M. F. O'Flaherty.) 8vo. Dublin, 1859.
19. Prize Essays on the Repeal of the Union. (Presented by the National Repeal Association.) 8vo. Dublin, 1845.
20. Greek Miscellany. 8vo. Hermonpolei, 1855.
21. Prayer Book of the Greek Church. 8vo. Benetia, 1859.
22. Hardiman's Irish Minstrelsy. 2 vols. 8vo. London, 1831.
23. Ossian's Poems, collected by John Smith, D. D. 8vo. Edinburgh, 1787.
24. Transactions of the Gaelic Society of Dublin, vol. I. 8vo. Dublin, 1808.
25. Gaelic Poems. 8vo. Perth, 1786.
26. Greek Miscellany. Athens, 1856.

27. Das Volksleben der Neugriechen. (Presented by a Greek Young Lady 'Ελπίς Γεννάδιος.) 8vo. Mannheim, 1844.
28. Greek Miscellany. 8vo. Athens, 1857.
29. Poems by A. R. Rangabe. (Presented by the Author.). 2 vols. 8vo. Athens, 1857.
30. Pamphlets by Dr. A. Dandolo. (Presented by the Author.) 8vo. Corfu, 1851.
31. Hibernian Nights' Entertainments, by S. Ferguson. (Presented by the Publishers.) 8vo. New York, 1857.
32. Allgemeines Evangelisches Gessang, und Gebetbuch zum Kirchen und Hausgebranch. 8vo. Hamburg, 1846.
33. Bits of Blarney, by R. Shelton Mac Kenzie. (Presented by John Savage, 1859.) 8vo. New York (no date).
34. Speeches by Lord Plunket, edited by J. C. Hoey. (Presented by the Author.) 8vo. Dublin, 1856.
35. The Ballads of Ireland, edited by Edward Hayes. (Presented by P. D. Malone) (?) 2 vols. 8vo. Boston, 1857.
36. Διαφορα λιηγματα του Αλεξανδρου Ριζου Ραγκαβη. 8vo. Athens, 1855.
37. The Sisters, Inisfail, and other Poems, by Aubrey De Vere. (Presented by the Author). 8vo. London, 1861.
38. Lectures on America, by W. S. O'Brien. (Presented by A. M. Sullivan.) 12mo. Dublin, 1859.
39. Hyperion, by H. W. Longfellow. (Presented by T. F. Meagher.) Small 4to. Liverpool, 1848.
40. Ballads, Poems, and Lyrics, by D. F. Mac Carthy. (Presented by the Author.) Small 4to. Dublin, 1850.
41. The Poets and Poetry of Munster, by Erionnach. (Presented by the Translator.) 12mo. Dublin, 1860.
42. Irish Popular Songs, by Edward Walsh. 12mo. Dublin, 1847.
43. Lucerna Fidelium, Authore Fr. Francis Molloy. 12mo. Romæ, 1676.
44. Speech of Wm. Smith O'Brien at Clonmel, 1858. (Presented by A. M. Sullivan.)
45. Οἱ 'Ελληνικοι Κωδικες. (Presented by G. A. Rhally, 1856.) 12mo. Athens, 1856.
46. God's Way of Peace, by Dr. Bonar. (Presented by R. Mahony, 1863.) 12mo. London, 1862.
47. Ireland, Native and Saxon, by Daniel O'Connell, M.P. (Presented by M. Casserly, New York.) 16mo. New York, 1843.
48. Talfourd's Three Speeches on Copyright. (Presented by the Author.) 16mo. 1840.
49. The Genealogy of the Right Hon. H. O'Brien, Earl of Thomond. (Presented by Mr. Geraghty, 1844.) 16mo. Dublin, 1841.
50. Imitation of Christ, in four books. (Presented by C. A. Harris, 1848.) 16mo. Oxford, 1847.
51. Choix des Penseés de B. Pascal. (Presented by Mrs. Sams.) 16mo. London, 183

52. Timothy O'Sullivan's Pious Miscellany. Edited by J. O'Daly. Presented by the Editor.) 16mo. Dublin, 1858.

53. Recueil de Chansons Canadiennes et Françaises, divise en deux parties. (Presented by A. Kierokowski.) 16mo. Montreal, 1859.

54. "Greek Songs." 16mo. Athens, 1862.

55. "Greek Miscellany." 16mo. Athens, 1821.

56. Map of United States. 18mo.

57. Public Procession and Dinner to W. S. O'Brien in Limerick, December 4, 1843. (Presented by Mr. Redmond, of Dublin, 1843.) 18mo.

58. Greek Songs. 18mo. Athens, 1862.

59. Teagask Chreestye. 16mo. Dublin (no date).

60. Imitation of Christ. (Presented by Professors of Maynooth College.) 18mo. 1822.

61. *Συνοψεως ἱερας μερος πρωτον.* 16mo. *Βενετια*, 1860.

62. The Evergreen. (Presented by W. S. O'Brien's mother, 1848). 24mo. London (no date).

63. Ballades et Chants Populaires de la Roumanie. Translated by V. Alexander (Presented by George Boudescon.) 12mo. Paris, 1855.

64. Consolatio; or, Comfort for the Afflicted. (From A. O'Brien.) 12mo. London, 1845.

65. Dramas of Calderon. Translated by Denis F. Mac Carthy. 2 vols. 8vo. (From the Author.) London, 1853.

66. Tennyson's "In Memoriam." (From W. S O'Brien's sister Ellen.) 8vo. London, 1850.

67. Lord Brougham's Translation of the Orations of Demosthenes. (From H. Dowling, 1854.) 8vo. London, 1840.

68. Poems, by R. Monckton Milnes. (From the Author.) 8vo. London, 1844

69. Barnes' Euripides, in 6 vols. (Vol. III. missing). (Presented by

Rev. Joseph Carson, D. D.; John F. Waller, LL.D.; John Kells Ingram, LL. D.; John Anster, LL. D.; R. R. Madden, M. D.; Rev. George Longfield, M. A.; and Very Rev. Charles Graves, D. D.: on the Committee of Polite Literature.

John T. Gilbert, Esq.; Rev. William Reeves, D. D.; W. H. Hardinge, Esq.; Sir W. R. Wilde, M. D.; Charles Haliday, Esq.; Colonel Meadows Taylor; and Denis H. Kelly, Esq.: on the Committee of Antiquities.

TREASURER.—Rev. Joseph Carson, D. D.

SECRETARY OF THE ACADEMY.—Rev. William Reeves, D. D.

SECRETARY OF THE COUNCIL.—John Kells Ingram, LL. D.

SECRETARY OF FOREIGN CORRESPONDENCE.—Sir W. R. Wilde, M. D.

LIBRARIAN.—John T. Gilbert, Esq.

CLERK, ASSISTANT LIBRARIAN, AND CURATOR OF THE MUSEUM.—Edward Clibborn, Esq.

The following persons were elected Honorary Members of the Academy:—

IN SCIENCE.—R. Clausius; Michel Chasles; and Charles Darwin.

IN POLITE LITERATURE.—John Lothrop Motley.

IN ANTIQUITIES.—Rev. S. Nilsson; Albert Way; and Benjamin Thorpe.

The Very Rev. Charles Graves, D. D., having retired from the Chair, Dr. Anster was called thereto.

It was moved by the Earl of Dunraven; seconded by the Rev. Dr. Carson; and passed by acclamation—

"That the hearty thanks of the Academy are due, and are hereby returned, to their late President, the Very Rev. Charles Graves, D. D., for the dignity, courtesy, and ability with which during the past five years he has filled the Chair; for his watchful attention to their interests, and for his zeal in labouring to uphold their honour and independence as a scientific and literary body."

MONDAY, APRIL 9, 1866.

Lord Talbot de Malahide, President, in the Chair.

Archibald Collum, Jun., Esq.; Lieut.-Colonel Edward Cooper, M.P.; the Rev. James Gaffney; Edward Hudson Kinahan, Esq.; W. H. S. Westropp, Esq.; Alexander G. More, Esq.; John A. Byrne, M.D.; and J. K. Forrest, Esq., were elected members of the Academy.

The President then delivered the following

Inaugural Address.

Gentlemen,—Permit me, in the first place, to tender you my respectful thanks for the kind manner in which you have been pleased to elect me to the Chair of this illustrious Society. I shall always value it as one of the highest honours which could be conferred on an Irish gentleman. I am, at the same time, fully conscious of my many shortcomings, and am well aware that there are many individuals amongst you who have higher claims for this distinction, from their researches in science, their discoveries in physics, their unwearied attention to the great questions of archæology, and their achievements in the field of polite literature. There was one man to whom we particularly owed this acknowledgment of his great services—I allude to George Petrie, on whom our late President passed so eloquent, so heart-stirring, and so well-deserved an encomium, at one of our last meetings. Alas! he has left us; and it remains for the surviving members of our body to follow up his great discoveries, and to illustrate fully the pages of early Irish history. We must not, however, be remiss in our endeavours to secure for his family some recognition of his patriotism, and some reward for his labours. I trust that the Government of this great country will not be deaf to our appeal on behalf of his bereaved family, and that posterity will be able to years; and I have a melancholy pleasure in remembering that he was my guest at the last meeting of the British Association for the Advancement of Science in this city. The time has gone by when Science was sneered at by practical men as useless, and a matter of pure curiosity. Its many applications to every-day life have of late attracted public attention, and the wonderful economic revolutions which have been witnessed during the last fifty years are entirely due to its influence. It is not equally well known how much the other branches of our Society owe to the habits of patient induction and close reasoning, which have flowed from the adoption of the Baconian system. This part of the subject has more than once been cursorily alluded to by some of my predecessors in the Chair; but I trust that I shall be forgiven if I mention a few instances and examples by way of illustration. I may remind you of the assistance which astronomy has given to the investigators of history and chronology in the determination of the dates of the battle of Clontarf, and of Julius Cæsar's first landing in Britain, by the consideration of the tides. I appeal to the triumphant efforts to decipher hieroglyphic and cuneiform inscriptions; and, though last, not least, the extinct Ogham character—I appeal to the use of the microscope in confirming the traditions as to the fact of the skins of sacrilegious Danes having been nailed to church doors—I appeal to the light thrown by chemistry on the curious questions connected with vitreous forts, on the composition of ancient bronze, on the nature of the colours of the ancients—I appeal to the evidences which botany and comparative anatomy have brought to light on the dark periods of history, on extinct animals, on the origin and habits of primæval races. Lastly, I appeal to the connexion between scientific geology and archæology. These two pursuits have always been more or less connected, but they are becoming every day more closely interwoven with each other; and within the last few years the discoveries of Professor Keller, of Zurich, and M. Boucher de Perthes; the deposits of Amiens and Abbeville; the crannoges of Ireland and Scotland; the lacustrine dwellings of Switzerland, Germany, and Italy; the caves of Sicily, France, Belgium, and England, have displayed a new page in history of surpassing interest, but in which the calmest and most honest spirit of inquiry is required, in order not to be carried away by wild theories and extravagant assumptions.

But perhaps the most glorious achievement of the present day is the progress of geology as a science. There are still a few survivors of that gallant band of philosophers who founded the London Geological Society. But what changes have they not witnessed in the progress of their science? Beginning as pupils of Werner, they were compelled to adopt the theories of Hutton and Playfair, based as they were on Sir James Hall's chemical experiments. The early ideas as to the formation of the so-called primitive rocks were completely demolished, and public attention was invited to the interesting phenomena of volcanoes and the effects of metamorphism. The next step was the discovery by Cuvier of the test derived from the presence of fossiliferous deposits as a criterion of the comparative age of different formations. Thenceforth palæontology, comparative anatomy, and conchology became essential part of geological study. The chronology of secondary strata, under the guidance of Smith, first assumed a definite form in these islands. The character of the Flora and Fauna of the old world developed itself generally, showing the changes of climate, and the gradual refrigeration of the globe. Here mathematics asserted their claims, and the questions of central heat, earthquakes, and the elevation of mountain charts, were brought within the domain of pure science. The next discoveries were those which proceeded from the study of the Alpine glaciers. Agassiz and his followers have proved the prevalence of a glacial period, during which the temperature of the earth assumed a point of cold quite inconsistent with the previous and subsequent epochs. The character of the fossils, the dispersion of erratic flocks, the discovery of arctic animals in these temperate climes, corroborated this theory by independent results. The present aspect of the science is highly satisfactory. The formation of the geological survey of these islands, the general adoption of similar undertakings in other countries, the publication of accurate geological maps on the Continent, the researches of travellers in all parts of the world, are adding every day to our intimate knowledge of the formation of the crust of the globe.

As a proof what can be done to create a science even within the short life of man, I have thought it right to give this short review of what has been done in the matter of geology. I am well aware that we possess in this city an excellent Society, specially directed to the working out of this subject. I have long been a member of it, and can bear witness to its high position; but we cannot give up our connexion with any science, particularly one of so much interest and importance; and one of the great values of an institution like ours is to direct and encourage the exertions of kindred societies, as well as to give a helping hand to those of our members who devote themselves to those pursuits. I cists and the Classicists, are questions of the past. The victory has remained with our national bard, and all interest is now concentrated on the powers of execution, and critical rules and dogmas are utterly discarded.

Metaphysics, again, which a few years since were so popular a course of intellectual amusement, seem almost forgotten, even on their favourite ground, the Scotch Universities.

I fear it must be admitted that, with the prevalence of utilitarianism and political economy, poetry and the works of the imagination have fallen into the background. There is still a Tennyson, and there are some beautiful poems by our Transatlantic brethren; but lyrics and ballad poetry, in which Ireland still continues to excel, have displaced the epics and tragedies of our fathers. The progress of periodical literature and novel writing has also contributed to this result. Doubtless, by this means a more general diffusion of a certain kind of knowledge and taste has taken place; but it is a question whether the desultory reading now so prevalent has not tended to wean young students from habits of close thought, and from the perusal of standard works of literature.

There always will be a class of educated men, the bent of whose mind will not be directed towards abstract science, and polite literature has hitherto been their congenial pursuit. On this account it is most desirable that literature should be kept up to a high standard; and I cannot but regret the prejudice, which seems to be on the increase, against the study of the Classics. It cannot be denied that in some of our public schools too much time has been devoted to the practice of Latin and Greek composition; but I am sure it would be a matter of regret to find the Irish gentleman less able to appreciate the works of Homer, Virgil, Horace, and the great orators and historians of Greece and Rome in their own language. It cannot, however, be said that we have neglected all questions appertaining to polite literature. Philology is still popular; and the able papers of Dr. Hincks must occur to every mind.

The efforts, also, which have been made to illustrate our Celtic literature must command the respect of every friend of Ireland. The publications of the Irish Archæological and Celtic Society, in which some of our members have had so great a share, have raised us much in the estimation of foreigners; and the edition of the "Brehon Laws," now in course of publication, is one of the most valuable contributions to the materials of history in our days. I need not say that these great works could hardly have been attempted without the assistance of two members of this Academy, whose loss we can never cease to regret.

It now remains for us to digest thoroughly these materials, and to turn them to good account. Before doing so, however, it is most essential that a complete and reliable Irish Dictionary should be compiled and printed. There are considerable materials already collected for this purpose; and our lamented member, the late Mr. Elliot Hudson, has placed a considerable sum at our disposal in order to carry it out. I trust that with a little exertion this great object may be attained.

It is much to be regretted that no standard history of Ireland has yet appeared. There has been such an improvement in the mode of writing history—Kemble, Lappenberg, and Thierry have done so much for Saxon and early Norman times—Hallam, Lingard, Froude, and Turner have shown how much light can be thrown on history by availing ourselves of sources of information hitherto disregarded, and discarding traditions which are not supported by trustworthy evidence—that the time is almost ripe for systematizing Irish history. It is true that the bitterness of party (although now much moderated among the educated and respectable classes) offers considerable difficulty in the way of an impartial statement of facts. However, I cannot believe that it would be a hopeless task to compile a fair history of Ireland up to the commencement of the sixteenth century. It is right that all Irishmen should have an opportunity of reading, in an authentic and trustworthy shape, the real history of their country. They ought to know all that can be determined as to the habits, customs, ideas, and general civilization of their ancestors. Poison enough has been distilled from unauthentic sources: we require the honey which is sure to reward the candid inquirer. Doubtless they would have to wade through a chronicle full of great crimes, and sometimes great virtues; but I feel confident that every candid man would rise from its perusal with a feeling of self-congratulation that his lot was cast in more peaceful times. In approaching the subject of archæology, to which I must confess I am enthusiastically attached, it would be out of place if I alluded in more than general terms to those details which can be studied with so much advantage in your "Proceedings" and "Transactions." It is a subject full of painful recollections. We have lost within a few years O'Donovan, O'Curry, and Petrie. Their loss is irreparable, but they have left a precious legacy behind them.

Another painful subject is to hear on every side of the diminution of of our archæologists are so unremitting, and that not a month passes without some addition being made to our treasures of ancient art, and to our knowledge of antiquity. The most important of these discoveries is due to the excavations of Mr. Conwell in the neighbourhood of Oldcastle, under the patronage of the patriotic James Naper, of Loughcrew.

The state of the Museum is most satisfactory. The excellent "Catalogue Raisonné," which has been compiled and published under the care of Sir William Wilde, has extended the sphere of our operations, by diffusing an accurate knowledge of the specimens in our Museum, and spread throughout the scientific world, both at home and abroad, an increasing interest in these subjects. I understand that the sales have covered the expense of the publication incurred by the Academy, and that this great and laborious work, of which its accomplished author may be justly proud, will soon be completed.

It has been suggested that a permanent director of the Museum is much required. I fully agree in the propriety of the suggestion; and I trust that the Committee of Antiquities will lose no time in maturing a proposition to this effect. Our Library is also most valuable. The collection of Irish Manuscripts is unrivalled. The want of a proper catalogue has been long felt, but I am sure that our Librarian will leave no stone unturned to put it in a proper state. I am rejoiced to hear that the services of a competent transcriber have been secured.

In conclusion, let us all singly and collectively work together to strengthen the hands of your Council and the Committees in their great work. We are, in a great measure, free from those jealousies and heartburning which are so fatal to the prosperity of our land. Let us continue to present a bright example of what can be done by a cordial union and co-operation of all classes, all parties, and all creeds, to heal the wounds of our beloved country, to diffuse a wholesome spirit of inquiry into all matters of scientific interest, to elevate the character of our literature, to discountenance those opinions which in some countries degrade man as a responsible and intellectual being, convert knowledge from being a blessing into a curse, sap the morals of the people, and discourage the efforts of those who are disposed to promote the true interests of their fellow-subjects. Let us not despair of the future of Ireland, but trust, with the blessing of God, to see it a free, happy, and united land.

It was moved by the Very Rev. C. Graves, D. D., and seconded by the Right Hon. the Lord Chancellor; and

Resolved,—That the President be requested to allow the Address now read to be printed, and circulated among the members of the Academy.

The following paper, by Mr. John Casey, A.B., Sch. Trin. Coll. Dublin, was read:

ON THE EQUATIONS AND PROPERTIES—(1) OF THE SYSTEM OF CIRCLES TOUCHING THREE CIRCLES IN A PLANE; (2) OF THE SYSTEM OF SPHERES TOUCHING FOUR SPHERES IN SPACE; (3) OF THE SYSTEM OF CIRCLES TOUCHING THREE CIRCLES ON A SPHERE; (4) ON THE SYSTEM OF CONICS INSCRIBED TO A CONIC, AND TOUCHING THREE INSCRIBED CONICS IN A PLANE.

IN the following Paper I shall give—1°. The method of investigating the equations of the circles in pairs which touch three given circles in a plane; 2°. the equations of the spheres in pairs which touch four given spheres; 3°. the equations of the circles in pairs which touch three others on the surface of a sphere; 4°. the equations in pairs of the conics having double contact with a given conic which touch three other conics having also double contact with the same given conic.

In the course of the investigation I shall, besides giving the methods by which I discovered the equations, indicate other methods which subsequently occurred to me, and shall show that some of the results are but generalizations of equations with which geometers have been long familiar.

I.

EQUATIONS OF THE CIRCLES WHICH TOUCH THREE OTHERS.

ART. 1.—If A, B, C, D, be four points on a line disposed in any manner, then always, none of the four being at infinity,

$$BC\cdot AD + CA\cdot BD + AB\cdot CD = 0, \qquad (1)$$

regard being had to the signs as well as to the magnitude of the six segments involved—Townsend's "Modern Geometry," vol. i., p. 102. Now, let A, B, C, D, be the points of contact of four circles which touch the line, and whose diameters are δ, δ', δ'', δ''', then, dividing

"If S, S', S'', S''', be four circles which touch a fifth circle Σ, the common tangent of $S\,S'$ by the common tangent of $S''\,S'''$ plus the common tangent of S', S'' by the common tangent of S, S''', plus the common tangent of S'', S, by the common tangent of $S'\,S''' = 0$; the common tangent of any pair of circles being direct or transverse, according as their contacts with Σ are similar or dissimilar."

The foregoing theorem being the foundation of nearly the whole of the following Paper, I shall in a subsequent article give another proof of it, not derived, like the preceding, from inversion, and which, slightly modified, will give the corresponding theorem respecting four circles which touch a fifth circle on the surface of a sphere.

2. If we denote the direct common tangents to S', S''; S'', S; S, S'; by

$$l^{\frac{1}{2}},\ m^{\frac{1}{2}},\ n^{\frac{1}{2}}, \text{ respectively,}$$

and the transverse common tangents by

$$l'^{\frac{1}{2}},\ m'^{\frac{1}{2}},\ n'^{\frac{1}{2}};$$

and supposing the fourth circle S''' to become a point, the common tangents to S''', S; S''', S'; S''', S''; become the square roots of the results of substituting the co-ordinates of the point S''' in the equations of the circles S, S', S'', respectively, and hence they are

$$\sqrt{S},\ \sqrt{S'},\ \sqrt{S''}.$$

Hence, the co-ordinates of any point in the circle touching $S\,S'\,S''$ must satisfy the equation

$$\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} = 0; \tag{2}$$

and since this equation, cleared of radicals, is of the fourth degree, it is the equation of a pair of circles, Σ, Σ', touching S, S', S'', as in fig. (1).

In like manner, the equations of the three other pairs of circles touching S, S', S'', are

$$\sqrt{lS} + \sqrt{m'S'} + \sqrt{n'S''} = 0 \tag{3}$$

$$\sqrt{l'S} + \sqrt{mS'} + \sqrt{n'S''} = 0 \tag{4}$$

$$\sqrt{l'S} + \sqrt{m'S} + \sqrt{nS''} = 0 \tag{5}$$

3. The equations of the inscribed and exscribed circles of a plane triangle are particular cases of the equations (2), (3), (4), (5), and may be inferred from them as follows:—Let the radii of the circles S, S', S'', be a, b, c, and let the angles in which they intersect each other be—

for	S', S'';	A;
,,	S'', S;	B;
,,	S, S';	C;

then it is easy to see that

$$2\cos\tfrac{1}{2}A = \sqrt{\frac{l}{bc}}$$

$$2\cos\tfrac{1}{2}B = \sqrt{\frac{m}{ca}}$$

$$2\cos\tfrac{1}{2}C = \sqrt{\frac{n}{ab}}$$

Substituting the values of $\sqrt{l}$, $\sqrt{m}$, $\sqrt{n}$, from these equations in equation (2), it becomes, by dividing by $2\sqrt{2abc}$,

$$\cos\tfrac{1}{2}A\sqrt{\frac{S}{2a}} + \cos\tfrac{1}{2}B\sqrt{\frac{S'}{2b}} + \cos\tfrac{1}{2}C\sqrt{\frac{S''}{2c}} = 0. \qquad (6)$$

Now, if S be a circle (fig. 2), and O a point whose co-ordinates are substituted in the equation of S, we have, if our equations be Cartesian,

$$\frac{S}{2a} = \frac{OP\cdot OQ}{PQ}.$$

And when the circle S becomes infinitely large, the limit of $OQ:PQ$ is unity. Hence the limits of $\frac{S}{2a}$, $\frac{S'}{2b}$, $\frac{S''}{2c}$, when $S\ S'\ S''$ becomes right lines, are the perpendiculars let fall on these lines, and denoting them by α, β, γ, the equation (6) becomes

$$\cos\tfrac{1}{2}A\sqrt{\alpha} + \cos\tfrac{1}{2}B\sqrt{\beta} + \cos\tfrac{1}{2}C\sqrt{\gamma} = 0. \qquad (7)$$

This is the equation of the circle inscribed in the triangle formed by the lines α, β, γ; and the exscribed circles may in like manner be derived from the equations (3), (4), (5).—Q. E. D.

4. The equation of the circle circumscribed about a triangle is also a particular case of equation (2). Thus, let S, S', S'', become points, denoting them by A, B, C, and the point S''' by D, then equation (2) becomes Ptolemy's theorem,

$$BC\cdot AD + CA\cdot BD + AB\cdot CD = 0.$$

Hence,

$$\frac{BC}{BD\cdot CD} + \frac{CA}{CD\cdot AD} + \frac{AB}{AD\cdot BD} = 0. \qquad (8)$$

Now, BC, CA, AB, are proportional to sin A, sin B, sin C; and if the equations of the lines BC, CA, AB, be α, β, γ, we have

$$BD \cdot CD = \alpha \cdot \text{diameter of circle};$$

$$CD \cdot AO = \beta \cdot \text{diameter of circle};$$

$$AD \cdot BD = \gamma \cdot \text{diameter of circle}.$$

Hence equation (8) becomes

$$\frac{\sin A}{\alpha} + \frac{\sin B}{\beta} + \frac{\sin C}{\gamma} = 0. \tag{9}$$

This is the equation of the circumscribed circle.

5. The equation of the inscribed circle of a plane triangle has been derived in Art. 3 from the equation (2) of a pair of circles touching three circles. Conversely, the equation of a pair of circles touching three others may be derived from the equation of the inscribed circle of a plane triangle.

For let Σ (fig. 3) be the circle inscribed in the triangle ABC, the equations of whose sides are $\alpha = 0$; $\beta = 0$; $\gamma = 0$; and let the circles S, S', S'', touch Σ at its points of contact with the sides of the triangle ABC; then denoting the radius of Σ by R, and the radii of S, S', S'', by r, r', r'', respectively; if any point Q be taken in Σ, the result of substituting the co-ordinates of Q in $S = 2(R - r)$ multiplied by the result of substituting the co-ordinates Q in α.

This may be written

$$\alpha = \frac{S}{2(R - r)};$$

in like manner,

$$\beta = \frac{S'}{2(R - r')};$$

and

$$\gamma = \frac{S''}{2(R - r'')}.$$

Again, since l denotes the direct common tangent to S', S'', it is easy to see that

$$\cos \tfrac{1}{2} A = \sqrt{\frac{l}{(R - r')(R - r'')}}.$$

In like manner,

$$\cos\tfrac{1}{2}B = \sqrt{\frac{m}{(R-r'')(R-r)}};$$

and

$$\cos\tfrac{1}{2}C = \sqrt{\frac{n}{(R-r)(R-r')}};$$

making these substitutions, the equation

$$\cos\tfrac{1}{2}A\sqrt{\alpha} + \cos\tfrac{1}{2}B\sqrt{\beta} + \cos\tfrac{1}{2}C\sqrt{\gamma} = 0$$

becomes transformed into

$$\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} = 0.$$

The equations of the other pairs of circles may be similarly derived from the equations of the exscribed circles.—Q. E. D.

6. The equation

$$\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} = 0,$$

when cleared of radicals, becomes

$$l^2S^2 + m^2S'^2 + n^2S''^2 - 2lmSS' - 2mnS'S'' - 2nlS''S = 0 \qquad (10)$$

Now, since this may be written in either of the equivalent forms

$$(lS - mS')^2 + nS''(nS'' - 2lS - 2mS') \qquad (11)$$

$$(mS' - nS'')^2 + lS(lS - 2mS' - 2nS'') \qquad (12)$$

$$(nS'' - lS)^2 + mS'(mS' - 2nS'' - 2lS) \qquad (13)$$

it follows that the pairs of circles

$$\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} = 0$$

touch S at the points $S = 0$, $mS' - nS'' = 0$;
,, S' ,, $S' = 0$, $nS'' - lS = 0$;
,, S'' ,, $S'' = 0$, $lS - mS' = 0$.

Hence, we have the following method of constructing the points of contact on the circles S, S', S'', with a pair of their tangential circles:—

Describe the circle $lS - mS' = 0$; this circle, coaxal with S, S', will intersect S'' in two points, which will be points of contact. Again, describe the circle $mS' - nS''$; it will intersect S in the points of contact. Lastly, describe the circle $nS'' - lS = 0$, and it will intersect S' in the points of contact.

7. Since the circle $lS - mS' = 0$ intersects $S'' = 0$ in the points of contact of S'' with the pair of circles $\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} = 0$,

$$lS - mS' - (l - m)\, S'' = 0$$

passes through the points of contact.

Now, $S - S'' = 0$ is the radical axis of the circles S, S'', and $S' - S'' = 0$ is the radical axis of the circles S', S''. Hence, denoting the radical axis of

$$\begin{array}{llll} S' & S'' & \text{by} & A, \\ S'' & S & ,, & A', \\ S & S' & ,, & A'', \end{array}$$

this equation becomes

$$mA - lA' = 0;$$

hence,

$$\frac{A}{l} - \frac{A'}{m} = 0.$$

In like manner, the points of contact on S are constructed by drawing the line

$$\frac{A'}{m} - \frac{A''}{n} = 0;$$

and the points on S' by drawing the line

$$\frac{A''}{n} - \frac{A}{l} = 0.$$

Hence we derive the following theorem :—

The chords of contact of the three circles S, S', S'', with their four pairs of tangential circles, are given by the four systems of equations—

$$\frac{A}{l} = \frac{A'}{m} = \frac{A''}{n} \tag{14}$$

$$\frac{A}{l} = \frac{A'}{m'} = \frac{A''}{n'} \tag{15}$$

$$\frac{A}{l'} = \frac{A'}{m} = \frac{A''}{n'} \tag{16}$$

$$\frac{A}{l'} = \frac{A'}{m'} = \frac{A''}{n}. \tag{17}$$

8. Since the discriminant of the equation (10) does not vanish, it follows that it is not the product of two simple factors of the form

$$\lambda S + \mu S' + \nu S'' = 0;$$

$$\lambda' S + \mu' S' + \nu' S'' = 0.$$

Hence the equation of a circle (Σ) touching three circles, S, S', S'', cannot be expressed in the form $\lambda S + \mu S' + \nu S'' = 0$.

9. The result of Art. 8 may be proved independently, as follows, and we can thence infer, conversely, that the discriminant of equation (10) ought not to vanish:—

For, if possible, let the equation of a circle (Σ) touching three circles S, S', S'', be of the form $\lambda S + \mu S' + \nu S'' \equiv \Sigma$.

Hence,

$$\lambda S + \mu S' \equiv \Sigma - \nu S''.$$

Now, since Σ touches S'', the circle $\lambda S + \mu S' = 0$, which is coaxal with S and S', also touches S'' at its point of contact with Σ; but we have seen (Art. 6) that the circle coaxal with S and S', which passes through the point of contact of Σ with S'', cuts S'', instead of touching it. Hence the equation of a circle touching S, S', S'', cannot be of the form $\lambda S + \mu S' + \nu S'' = 0$.—Q. E. D.

This conclusion accords with the fact that three circles, S, S', S'', being given, the form $\lambda S + \mu S' + \nu S'' = 0$ is not sufficiently general to express the equation of any fourth circle. For the equation of any circle contains three independent constants, while $\lambda S + \mu S' + \nu S'' = 0$ contains but two, viz., the ratios $\lambda : \nu$ and $\mu : \nu$.

10. The equations (11), (12), (13), of Art. 6, being all of the form $R^2 = LM$, hence the pair of circles $\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''}$ also touches the circles

$$lS - 2mS' - 2nS'' = 0;$$

$$mS' - 2nS'' - 2lS = 0;$$

$$nS'' - 2lS - 2mS' = 0.$$

Again, the circle $lS + mS' + nS''$ evidently passes through the intersections of the pairs of circles

$$S \text{ and } lS - 2mS' - 2nS'';$$

$$S' \text{ and } mS' - 2nS'' - 2lS;$$

$$S'' \text{ and } nS'' - 2lS - 2mS';$$

and is therefore coaxal with each pair. Hence the three lines joining the centres of these pairs of circles are concurrent. Hence we have the following theorem:—

The pair of circles $\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} = 0$ touching three circles, S, S', S'', also touches the three other circles

$$lS - 2mS' - 2nS'' = 0;$$
$$mS' - 2nS'' - 2lS = 0;$$
$$nS'' - 2lS - 2mS' = 0;$$

and the lines joining the centres of these circles to the centres of S, S', S'', respectively, concur to the centre of $lS + mS' + nS''$.

11. Since the equation (10) may be written in either of the following equivalent forms,

$$(lS + mS' - nS'')^2 = 4lmSS'; \tag{18}$$
$$(mS' + nS'' - lS)^2 = 4mn'SS''; \tag{19}$$
$$(nS'' + lS - mS')^2 = 4nlS''S; \tag{20}$$

we have the following theorem:—

The equations of the circles passing through the points of contact of the pair of circles $\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} = 0$ with

$$S, S' \text{ is } lS + mS' - nS'' = 0; \tag{21}$$
$$S', S'' \text{ ,, } mS' + nS'' - lS = 0; \tag{22}$$
$$S'' S \text{ ,, } nS'' + lS - Sm'' = 0. \tag{23}$$

12. We shall conclude this part of the subject of this Paper by applying our principles to prove Dr. Hart's celebrated extension of Feuerbach's theorem:—

"Taking any three of the eight circles which touch three others, a circle can be described to touch these three, and to touch a fourth circle of the eight touching circles."

Now, since the combinations in threes of eight things is $\frac{8 \cdot 7 \cdot 6}{1 \cdot 2 \cdot 3} = 56$, this theorem makes it necessary that we should have fourteen circles, which we divide into two systems of circles—one system containing eight circles, and the other containing six.

Since the eight circles which touch three given circles are, four of them, the inverse of the other four, with respect to the circle which cuts the three given circles orthogonally, they may be denoted in pairs thus:—

$$\alpha\alpha'; \quad \beta\beta'; \quad \gamma\gamma'; \quad \delta\delta';$$

then it is evident that

$$\sqrt{lS} + \sqrt{mS'} + \sqrt{nS''} \equiv \alpha\alpha'$$
$$\sqrt{lS} + \sqrt{m'S'} + \sqrt{n'S''} \equiv \beta\beta'$$
$$\sqrt{l'S} + \sqrt{m'S'} + \sqrt{nS''} \equiv \gamma\gamma'$$
$$\sqrt{l'S} + \sqrt{mS'} + \sqrt{n'S''} \equiv \delta\delta'$$

Now, the equation of the pair of circles $\alpha\alpha'$, when cleared of radicals, is by equation (18)

$$4\, lmSS' = (lS + mS' - nS'')^2;$$

and this being of the form $LM = R^2$, the equation of any circle touching α and α' will be of the form

$$\mu^2 L - 2\mu R + M = 0$$

(Salmon's "Conic Sections," p. 234, Fourth Edition); or, restoring the values of L, M, R,

$$(\mu^2 - \mu)lS - (\mu - 1)mS' + \mu nS'' = 0. \qquad (a)$$

Similarly, the equation of any circle touching the pair of circles $\beta\beta'$ will be of the form

$$(\mu'^2 - \mu')lS - (\mu' - 1)m'S' + \mu'n'S'' = 0. \qquad (b)$$

In order that equations (a) and (b) may represent the same circle, we must have

$$\frac{\mu}{\mu'} = \frac{m}{m'}$$

$$\frac{\mu - 1}{\mu' - 1} = \frac{n}{n'}.$$

for the system of six circles.

Hence μ and μ' are determined, which proves the proposition; and we have the following system of six circles:—

$\alpha\alpha'\beta\beta'$ are all touched by a fourth circle. (a)
$\alpha\alpha'\gamma\gamma'$,, (b)
$\alpha\alpha'\delta\delta'$,, (c)
$\beta\beta'\gamma\gamma'$,, (d)
$\beta\beta'\delta\delta'$,, (e)
$\gamma\gamma'\delta\delta'$,, (f)

And we see that from the relation between the system of eight circles,

$$\alpha, \beta, \gamma, \delta; \quad \alpha', \beta', \gamma', \delta';$$

and six circles,

$$(a), (b), (c), (d), (e), (f),$$

every circle of the former system is touched by three of the latter, and every circle of the latter by four of the former.—Q. E. D.

13. A very simple geometrical demonstration can be given of this part of Dr. Hart's theorem;—in fact, it is inferred at once from the following principle, which occurred to me some time since:—

If two circles, P', Q', be the inverse of two other circles, P, Q, with respect to the same circle, X, the four circles, P, Q, P', Q', have four common tangential circles.

This is evident.

14. Proof for the system of eight circles:—Let S, S', S'' (fig. 4), be the three given circles, any or all of which may be right lines, and α, β, γ, δ', four circles described touching them similar to the exscribed and inscribed circles of a plane triangle, I say, α, β, γ, δ', are all touched by a fourth circle, besides the three circles S, S', S''.

Demonstration.—Let the direct common tangent to a pair of circles, α and β, for instance, be denoted by the notation $\alpha\beta$, and the transverse commmon tangent by $\underline{\alpha\beta}$ with an understroke; then we have, attending only to the magnitudes of the rectangles, by Art. 1, since S is touched by β, γ, δ', on one side, and by α on the other,

$$\underline{\alpha\beta}\cdot\gamma\delta' + \underline{\alpha\delta'}\cdot\beta\gamma - \underline{\alpha\gamma}\cdot\beta\delta' = 0; \tag{a}$$

in like manner,

$$\underline{\alpha\gamma}\cdot\beta\delta' + \underline{\gamma\delta'}\cdot\alpha\beta - \underline{\beta\gamma}\cdot\alpha\delta' = 0; \tag{b}$$

and

$$\underline{\alpha\beta}\cdot\gamma\delta' + \underline{\beta\delta'}\cdot\alpha\gamma - \underline{\beta\gamma}\cdot\alpha\delta' = 0. \tag{c}$$

Hence, by adding equations (*a*) and (*b*), and subtracting equation (*c*), we get

$$\underline{\alpha\delta'}\cdot\beta\gamma + \underline{\gamma\delta'}\cdot\alpha\beta - \underline{\beta\delta'}\cdot\alpha\gamma = 0.$$

Hence the circles α, β, γ, δ', are all touched by a fourth circle having α, β, γ, on one side, and δ', on the other; hence we have the following system of eight circles:—

$\alpha, \beta, \gamma, \delta'$,	are all touched by a fourth circle.	(A)
$\alpha, \beta, \gamma', \delta$,	„	(B)
$\alpha, \beta', \gamma, \delta$,	„	(C)
$\alpha', \beta, \gamma, \delta$,	„	(D)
$\alpha', \beta', \gamma', \delta$,	„	(A′)
$\alpha', \beta', \gamma, \delta'$,	„	(B′)
$\alpha', \beta, \gamma', \delta'$,	„	(C′)
$\alpha, \beta', \gamma', \delta'$,	„	(D′)

This proves the theorem for the system of eight circles; and from the foregoing scheme we see that the relation between the two systems of eight circles, $\alpha, \beta, \gamma, \delta, \alpha', \beta', \gamma', \delta'$, and $A, B, C, D, A', B', C', D'$, is reciprocal, viz., each circle of each system being touched by four circles of the other system—a property which was also noticed by Dr. Hart.—Q. E. D.

II.

EQUATIONS OF THE SIXTEEN SPHERES IN PAIRS WHICH TOUCH FOUR OTHERS.

15. If A, B, C, D, be four points in a plane, then denoting their three pairs of connectors by the following notation,

$$
\begin{array}{llll}
BC, & AD, & \text{by} & l^{\frac{1}{2}}, \ p^{\frac{1}{2}}; \\
CA, & BD, & ,, & m^{\frac{1}{2}}, \ q^{\frac{1}{2}}; \\
AB, & CD, & ,, & n^{\frac{1}{2}}, \ r^{\frac{1}{2}};
\end{array}
$$

circle or sphere whose radius is K and centre at E, and denoting the connectors of the inverse points A', B', C', D', by the same notation as those of the points A, B, C, D, only with accents, also denoting EA', EB', EC', ED', by $\alpha^{\frac{1}{2}}$, $\beta^{\frac{1}{2}}$, $\gamma^{\frac{1}{2}}$, $\delta^{\frac{1}{2}}$,

Now it is evident that

$$l=\frac{K^4 l'}{\beta\gamma},\quad m=\frac{K^4 m'}{\gamma\alpha},\quad n=\frac{K^4 n'}{\alpha\beta},$$

$$p=\frac{K^4 p'}{\alpha\delta},\quad q=\frac{K^4 q'}{\beta\delta},\quad r=\frac{K^4 r'}{\gamma\delta}.$$

Hence, making these substitutions in equation (24), clearing of fractions, and omitting the accents as being no longer necessary, we have the following theorem:—

If A, B, C, D, E, be any five points in a plane, or on the surface of a sphere, and if the connectors in pairs of the points A, B, C, D, be denoted by $l^{\frac{1}{2}}$, $p^{\frac{1}{2}}$; $m^{\frac{1}{2}}$, $q^{\frac{1}{2}}$; $n^{\frac{1}{2}}$, $r^{\frac{1}{2}}$; and the connectors EA, EB, EC, ED, by $\alpha^{\frac{1}{2}}$, $\beta^{\frac{1}{2}}$, $\gamma^{\frac{1}{2}}$, $\delta^{\frac{1}{2}}$, then the relation

$$\begin{aligned} &lrq\alpha^2+mpr\beta^2+npq\gamma^2+lmn\delta^2+(lp-mq-nr)(l\alpha\delta+p\beta\gamma)\\ &+(mq-nr-lp)(m\beta\delta+q\alpha\gamma)+(nr-lp-mq)(n\gamma\delta+r\alpha\beta)=0, \qquad (26)\end{aligned}$$

or its equivalent, the determinant,

$$\begin{vmatrix} 0, & n, & m, & p, & \alpha \\ n, & 0, & l, & q, & \beta \\ m, & l, & 0, & r, & \gamma \\ p, & q, & r, & 0, & \delta \\ \alpha, & \beta, & \gamma, & \delta, & 0 \end{vmatrix}=0,$$

holds between these connectors.

16. The equation (26) between the connectors of five points on the surface of a sphere is the analogue of Ptolemy's theorem for four points on a circle, and can be enunciated in a very concise manner by the help of the following considerations:—

1°. The entire number of lines of connexion of five points $=\dfrac{5\times 4}{1\cdot 2}=10$.

2°. The entire number of triangles which can be formed by combining the five points, three by three, is $\dfrac{5\times 4\times 3}{1\cdot 2\cdot 3}=10$.

3°. The entire number of pentagons which can be formed having the five points for vertices $=\dfrac{4\times 3\times 2\times 1}{2}=12$.

Then, the sum of the ten products formed by multiplying the fourth power of the line joining any two points by the continued product of the squares of the sides of the triangle of which the three remaining points are vertices is equal to the sum of the twelve products formed, each, by multiplying together the squares of the sides of each of the twelve pentagons of which the five points are the vertices.

17. Supposing the points A, B, C, D, E, of Art. 14 to be on a plane, and that spheres whose diameters are δ, δ', δ'', δ''', δ'''', touch the plane in those points; then inverting the whole from any arbitrary point in space, and denoting the common tangents to the inverse spheres by the same notation as that of Art. 14, viz., the common to the

inverse of the spheres at B, C, by l^1;
" " A, D, " p^1;

and so on; then we have from equation (21) the following theorem:—

If five spheres, A, B, C, D, E, touch a sixth sphere, Σ, the relation

$$\begin{vmatrix} 0, & n, & m, & p, & a, \\ n, & 0, & l, & q, & \beta, \\ m, & l, & 0, & r, & \gamma, \\ p, & q, & r, & 0, & \delta, \\ a, & \beta, & \gamma, & \delta, & 0, \end{vmatrix} = 0 \qquad (27)$$

holds between the common tangents of the five spheres, the common tangent to any pair of spheres being the direct or transverse, according as the pair of spheres to which it is drawn have contacts of the same or of opposite kinds with the sixth sphere, Σ.

18. The theorem of Art. 17 is an extension of the theorem of Art. 15, analogous to the extension which the theorem in Art. 1 is of Ptolemy's theorem, and an analogous use can be made of it.

For, supposing the sphere at the point E to reduce to a point, and denoting the other four spheres by S, S', S'', S''', then we get the equation of the pair of spheres touching S, S,' S,'' S''',

$$\begin{vmatrix} 0, & n, & m, & p, & S \\ n, & 0, & l, & q, & S' \\ m, & l, & 0, & r, & S'' \\ p, & q, & r, & 0, & S''' \\ S, & S' & S'' & S''' & 0 \end{vmatrix} = 0, \qquad (28)$$

precisely in the same way as the equation of the pair of circles touching three circles was derived in Art. 2.—Q. E. D.

19. Denoting the equation (28), for shortness, by the notation $\phi(l, m, n, p, q, r,) = 0$, and the transverse common tangents by the same notation as the direct common tangents, only with accents, and we have the following seven equations for the other seven pairs of spheres which touch S, S', S'', S''', viz.,

$$\phi(l,\ m',\ n',\ p',\ q,\ r,) = 0; \tag{29}$$
$$\phi(l',\ m,\ n',\ p,\ q',\ r,) = 0; \tag{30}$$
$$\phi(l',\ m',\ n,\ p,\ q,\ r',) = 0; \tag{31}$$
$$\phi(l,\ m,\ n,\ p',\ q',\ r',) = 0; \tag{32}$$
$$\phi(l',\ m',\ n,\ p',\ q',\ r,) = 0; \tag{33}$$
$$\phi(l,\ m',\ n',\ p,\ q',\ r',) = 0; \tag{34}$$
$$\phi(l',\ m,\ n',\ p',\ q,\ r',) = 0; \tag{35}$$

20. In precisely the same manner as in Art. 3 we derived the equations of the inscribed and exscribed circles of a plane triangle from the equations of the pairs of circles touching three circles, we can derive the equations of the eight spheres which touch the four faces of a tetrahedron from the equations of Arts. 18 and 19. Thus the equation of the inscribed sphere is, the faces being x, y, z, w, derived from equation (28)

$$\begin{vmatrix} 0, & \cos^2\frac{1}{2}(xy), & \cos^2\frac{1}{2}(xz), & \cos^2\frac{1}{2}(xw), & x \\ \cos^2\frac{1}{2}(yx), & 0, & \cos^2\frac{1}{2}(yz), & \cos^2\frac{1}{2}(yw), & y \\ \cos^2\frac{1}{2}(zx), & \cos^2\frac{1}{2}(zy), & 0, & \cos^2\frac{1}{2}(zw), & z \\ \cos^2\frac{1}{2}(wx), & \cos^2\frac{1}{2}(wy), & \cos^2\frac{1}{2}(wz) & 0, & w \\ x, & y, & z, & w, & 0 \end{vmatrix} = 0, \tag{36}$$

and the equations of the seven others are derived from equations (29)-(35).

21. Again, in the same way exactly as we derived the equations of the circles in pairs which touch three circles from the equations of the inscribed and exscribed circles of a plane triangle, we might derive the equations of the spheres in pairs which touch four spheres from the equations of the spheres touching the faces of a tetrahedron; and, in fact, it was in that way I first derived the theorem.

22. If we form the tangential equation corresponding to equation (23), we find—

$$\mu\nu l + \nu\lambda m + \lambda\mu n + \lambda\rho p + \mu\rho q + \nu\rho r = 0. \tag{37}$$

This is the condition that the pair of spheres given by equation (28) may be touched by the sphere $\lambda S + \mu S' + \nu S'' + \rho S''' = 0$. We get similar equations from equations (29)–(35), inclusive; and since from any three of these equations we get eight systems of common values for λ, μ, ν, ρ, we infer that the three pairs of spheres denoted by any three of the equations (28)–(35) are touched by eight spheres, four of which are the spheres S, S', S'', S'''.

23. The eight tangential equations can all be included in one general formula, as follows:—

Let the radii of the four spheres, $S, S', S''\ S'''$, be denoted by r, r', r'', r''', and the angle at which S intersects S' by the notation (SS'), then we have

$$l = 4r'r'' \cos^2 \tfrac{1}{2}(S'S'');$$
$$l' = -\,4r'r'' \sin^2 \tfrac{1}{2}(S'S'');$$

and similar values for $m, m,'$ &c. Hence the equation (37) becomes transformed into

$$\lambda\mu rr' \cos^2 \tfrac{1}{2}(SS') + \mu\nu r'r'' \cos^2 \tfrac{1}{2}(S'S'') + \nu\rho r''r''' \cos^2 \tfrac{1}{2}(S''S''')$$
$$+ \lambda\nu rr'' \cos^2 \tfrac{1}{2}(SS'') + \lambda\rho rr''' \cos^2 \tfrac{1}{2}(SS''') + \mu\rho r'r''' \cos^2 \tfrac{1}{2}(S'S''').$$

This is equivalent to the equation

$$U = (\lambda r + \mu r' + \nu r'' + \rho r''')^2, \tag{38}$$

where

$$U \equiv \lambda^2 r^2 + \mu^2 r'^2 + \nu^2 r''^2 + \rho^2 r'''^2$$
$$-2\lambda\mu rr' \cos(SS') - 2\mu\nu r'r'' \cos(S''S'') - 2\nu\rho r''r''' \cos(S''S''')$$
$$-2\lambda\nu rr'' \cos(SS'') - 2\lambda\rho rr''' \cos(SS''') - 2\mu\rho r'r''' \cos(S'S'''). \tag{39}$$

And the eight tangential equations are included in the formula

$$U = (\lambda r \pm \mu r' \pm \nu r'' \pm \rho r''')^2 \tag{40}$$

(Compare Salmon's "Geometry of Three Dimensions," Art. 219.)

III.

EQUATIONS OF THE CIRCLES IN PAIRS WHICH TOUCH THREE CIRCLES ON A SPHERE.

24. The theorem, Art. 1, which was proved by inversion, can be proved without inversion, as follows:—

Let O, O', O'', O''', be the points of contact; A, B, C, D, the centres; r, r', r'', r''', the radii of four circles, S, S', S'', S''', which touch a fifth circle, Σ; and let G be the centre, and R the radius of Σ; then we have (fig. 5),

$$4\sin^2\tfrac{1}{2}AGB = \frac{AB^2-(BG-AG)^2}{AG\cdot GB} = \frac{AB^2-(r-r')^2}{(R-r)(R-r')}$$

$$= \frac{\text{square of common tangent of } S, S'}{(R-r)(R-r')}.$$

Again,

$$4\sin^2\tfrac{1}{2}AGB = \frac{OO'^2}{R^2}.$$

Hence,

$$OO' = \text{common tangent of } S,\ S', \times \frac{R}{\sqrt{(R-r)(R-r')}}. \qquad (41)$$

Now, by Ptolemy's theorem,

$$OO'\cdot O''O''' + O'O''\cdot OO''' + O''O\cdot O'O''' = 0.$$

Hence, substituting for OO', from (41), and making like substitutions for $O''O'''$, &c., we have the common tangent of S, S' by the common tangent of S'', $S''' +$ &c., $= 0$.

25. The proof given in the last Article is that alluded to in Art. 1; and it is evident that it may be proved in a manner precisely similar, if S, S', S'', S''', be four circles on the surface of a sphere touching a fifth circle, Σ, that the sin $\frac{1}{2}$common tangent of S, $S' +$ sin $\frac{1}{2}$ common tangent of S'', $S''' +$ sin $\frac{1}{2}$common tangent of S', $S'' \times$ sin $\frac{1}{2}$common tangent of S, $S''' +$ sin $\frac{1}{2}$common tangent of S'', $S \times$ sin $\frac{1}{2}$common tangent of S', $S''' = 0$, the common tangents being the direct or the transverse, according as the contacts of the pairs of circles to which they are drawn with Σ are similar or dissimilar.

26. The direct application of the theorem in the last two Articles gives at once a proof of Feuerbach's theorem for plane triangles, and of Dr. Hart's extension of it to spherical triangles.

For if S, S' S'', S''', be the inscribed and exscribed circles of a plane triangle, the common tangent of S, $S' = b - c$;

$$\text{,,} \qquad \text{of } S'', S''' = b + c.$$

Hence common tangent of S, $S' \times$ common tangent of S'', $S''' = b^2 - c^2$; and the other rectangles $= c^2 - a^2$, and $a^2 - b^2$, respectively. Hence the condition holds of S, S', S'', S''', being all touched by the same circle.—Q. E. D.

27. Again, if S, S', S'', S''', be the inscribed and exscribed circles of a spherical triangle, we have

$$\text{Sin}\tfrac{1}{2}\text{common tangent of } S, S' \times \sin\tfrac{1}{2}\text{common tangent of } S'', S''' = \sin^2\tfrac{1}{2}b - \sin^2\tfrac{1}{2}c;$$

and the other rectangles $= \sin^2\frac{1}{2}c - \sin^2\frac{1}{2}a$, and $\sin^2\frac{1}{2}a - \sin^2\frac{1}{2}b$, respectively. Hence the condition holds of the circles S, S', S'', S''', being all touched by the same circle.—Q. E. D.

28. It is evident that the three anharmonic ratios of the points of contact are

$$\frac{b^2-c^2}{c^2-a^2}, \quad \frac{c^2-a^2}{a^2-b^2}, \quad \frac{a^2-b^2}{b^2-c^2}, \tag{42}$$

for plane triangles; and for spherical triangles, they are

$$\frac{\sin^2\frac{1}{2}b - \sin^2\frac{1}{2}c}{\sin^2\frac{1}{2}c - \sin^2\frac{1}{2}a}, \quad \frac{\sin^2\frac{1}{2}c - \sin^2\frac{1}{2}a}{\sin^2\frac{1}{2}a - \sin^2\frac{1}{2}b}, \quad \frac{\sin^2\frac{1}{2}a - \sin^2\frac{1}{2}b}{\sin^2\frac{1}{2}b - \sin^2\frac{1}{2}c}. \tag{43}$$

29. Let P be the centre of a small circle S on the surface of a sphere (fig. 6); O a fixed point also on the surface, which we shall take as origin: OX a fixed great circle, corresponding to the initial line in plane geometry; and let $OP = n$, the angle $POX = m$, and the co-ordinates of any point Q of the circle S be ρ and θ, then we have from the spherical triangle OPQ, r being the radius of the circle S,

$$\cos r = \{\cos n \cos \rho + \sin n \sin \rho \cos (O - m)\} = 0. \tag{44}$$

This may be taken as the equation of the small circle S; and it is plain that with this system of co-ordinates the result of substituting the co-ordinates of any point Q' in the equation of a small circle S on the surface of a sphere is equal to

$$2\cos r \times \sin^2\tfrac{1}{2}\text{ the tangent from } Q' \text{ to } S.$$

This may be written

$$2\cos r \times \sin^2\tfrac{1}{2}t = S$$

$$\therefore \sin\tfrac{1}{2}t = \sqrt{\frac{S}{2\cos r}}. \tag{45}$$

30. If the small circle S''' of Art. 26 become a point, and if we denote the

sin $\frac{1}{2}$ direct common tangent of S', S'', by $l^{\frac{1}{2}}$,
,, S'', S ,, $m^{\frac{1}{2}}$,
,, S, S' ,, $n^{\frac{1}{2}}$.

and the sines of half the transverse common tangents by $l'^{\frac{1}{2}}$, $m'^{\frac{1}{2}}$, $n'^{\frac{1}{2}}$, we get from the theorem of Art. 25, and from equation (45), the equations of the four pairs of circles which touch three small circles on the surface of a sphere, as follows:—

$$\sqrt{\frac{lS}{\cos r}} + \sqrt{\frac{mS'}{\cos r'}} + \sqrt{\frac{nS''}{\cos r''}} = 0; \qquad (46)$$

$$\sqrt{\frac{lS}{\cos r}} + \sqrt{\frac{m'S'}{\cos r'}} + \sqrt{\frac{n'S''}{\cos r''}} = 0; \qquad (47)$$

$$\sqrt{\frac{l'S}{\cos r}} + \sqrt{\frac{mS'}{\cos r'}} + \sqrt{\frac{n\,S''}{\cos r''}} = 0; \qquad (48)$$

$$\sqrt{\frac{lS'}{\cos r}} + \sqrt{\frac{m'S'}{\cos r'}} + \sqrt{\frac{nS''}{\cos r''}} = 0. \qquad (49)$$

31. The four equations, (46)–(49), when expanded, are equivalent to the following determinants:—

$$\begin{vmatrix} 0, & \frac{l}{\cos r'}, & \frac{m}{\cos r''}, & S \\ \frac{l}{\cos r'}, & 0, & \frac{n}{\cos r'''}, & S' \\ \frac{m}{\cos r'}, & \frac{n}{\cos r''}, & 0, & S'', \\ S, & S', & S'', & 0, \end{vmatrix} = 0. \; (50) \qquad \begin{vmatrix} 0, & \frac{l}{\cos r}, & \frac{m'}{\cos r'}, & S, \\ \frac{l}{\cos r}, & 0, & \frac{n'}{\cos r''}, & S', \\ \frac{m'}{\cos r'}, & \frac{n'}{\cos r''}, & 0, & S'', \\ S, & S', & S', & 0, \end{vmatrix} = 0. \; (51)$$

$$\begin{vmatrix} 0, & \frac{l'}{\cos r'}, & \frac{m}{\cos r''}, & S, \\ \frac{l'}{\cos r'}, & 0, & \frac{n'}{\cos r''}, & S', \\ \frac{m}{\cos r''}, & \frac{n'}{\cos r''}, & 0, & S'', \\ S, & S', & S'', & 0, \end{vmatrix} = 0. \; (52) \qquad \begin{vmatrix} 0, & \frac{l'}{\cos r}, & \frac{m'}{\cos r'}, & S, \\ \frac{l'}{\cos r}, & 0, & \frac{n}{\cos r''}, & S', \\ \frac{m'}{\cos r'}, & \frac{n'}{\cos r''}, & 0, & S'', \\ S, & S', & S', & 0, \end{vmatrix} = 0. \; (53)$$

And the four corresponding tangential equations are—

$$\frac{l}{\lambda \cos r} + \frac{m}{\mu \cos r'} + \frac{n}{\nu \cos r''} = 0; \tag{54}$$

$$\frac{l}{\lambda \cos r} + \frac{m'}{\mu \cos r'} + \frac{n'}{\nu \cos r''} = 0; \tag{55}$$

$$\frac{l'}{\lambda \cos r} + \frac{m}{\mu \cos r'} + \frac{n'}{\nu \cos r''} = 0; \tag{56}$$

$$\frac{l'}{\lambda \cos r} + \frac{m'}{\mu \cos r'} + \frac{n}{\nu \cos r''} = 0. \tag{57}$$

32. The proofs given in Articles 12 and 14 for Dr. Hart's extension of Feuerbach's theorem, it is evident, apply *verbatim* for the analogous theorem concerning circles on the sphere; and the part of it concerning the system of six circles, Art. 12, may also be inferred immediately from the equations (54)–(57); for any two of these equations are sufficient to determine the ratios $\lambda : \nu$ and $\mu : \nu$. Hence the four circles denoted by any pair of the equations (54)–(57) have a common tangential circle, besides the three circles S, S', S''.—Q. E. D.

33. The equations of the inscribed and exscribed circles of a spherical triangle may be inferred from equations (46)–(49).

For, denoting the angles at which they intersect

S' and S'' by A;
S'' and S ,, B;
S and S' ,, C;

it is easy to see that

$$2 \cos \tfrac{1}{2} A = \sqrt{\frac{l}{\tan r' \tan r''}}$$

$$2 \cos \tfrac{1}{2} B = \sqrt{\frac{m}{\tan r'' \tan r}}$$

$$2 \cos \tfrac{1}{2} C = \sqrt{\frac{n}{\tan r \tan r'}}$$

Hence equation (46) becomes transformed into

$$\cos \tfrac{1}{2} \sqrt{\frac{S}{\sin r}} + \cos \tfrac{1}{2} B \sqrt{\frac{S'}{\sin r'}} + \cos \tfrac{1}{2} C \sqrt{\frac{S''}{\sin r''}} = 0. \tag{58}$$

And if the circles S, S', S'', become great circles, denoting them by α, β, γ, we get for the equation of the inscribed circle of a spherical triangle—

$$\cos \tfrac{1}{2}A\sqrt{\alpha} + \cos^2 \tfrac{1}{2}B\sqrt{\beta} + \cos \tfrac{1}{2}C\sqrt{\gamma} = 0\,; \tag{59}$$

and the equations (47)–(49) give, when similarly transformed, the equations of the exscribed circles.

34. The tangential equations (54)–(57) become, by the substitutions of the last articles,

$$\frac{\cos^2 \frac{1}{2}A}{\lambda \sin r} + \frac{\cos^2 \frac{1}{2}B}{\mu \sin r'} + \frac{\cos^2 \frac{1}{2}C}{\nu \sin r''} = 0\,; \tag{60}$$

$$\frac{\cos^2 \frac{1}{2}A}{\lambda \sin r} - \frac{\sin^2 \frac{1}{2}B}{\mu \sin r'} - \frac{\sin^2 \frac{1}{2}C}{\nu \sin r''} = 0\,; \tag{61}$$

$$-\frac{\sin^2 \frac{1}{2}A}{\lambda \sin r} + \frac{\cos^2 \frac{1}{2}B}{\mu \sin r'} - \frac{\sin^2 \frac{1}{2}C}{\nu \sin r''} = 0\,; \tag{62}$$

$$-\frac{\sin^2 \frac{1}{2}A}{\lambda \sin r} - \frac{\sin^2 \frac{1}{2}B}{\mu \sin r'} + \frac{\cos^2 \frac{1}{2}C}{\nu \sin r''} = 0. \tag{63}$$

These formulæ are all included in the general formula

$$U = (\lambda \sin r \pm \mu \sin r' \pm \nu \sin r'')^2, \tag{64}$$

where

$$\begin{aligned} U \equiv\ & \lambda^2 \sin^2 r + \mu^2 \sin^2 r' + \nu^2 \sin^2 r'' \\ & - 2\mu\nu \sin r' \sin r'' \cos A - 2\nu\lambda \sin r'' \sin r \cos B \\ & - 2\lambda\mu \sin r \sin r' \cos C. \end{aligned} \tag{65}$$

35. The equations (60)–(63) denote the eight circles tangential to three circles on the sphere, and each pair are touched by the pair of circles

$$\begin{aligned} U = \{ & \lambda \sin r \cos (B - C) + \mu \sin r' \cos C - A) \\ & + \nu \sin r'' \cos (A - \mathrm{B}) \}^2 \end{aligned} \tag{66}$$

(See Salmon's "Geometry of Three Dimensions," Second Edition, Art. 253).

The pair of circles (66) correspond to the circles A, A' of Art. 14; and the circles corresponding to the pairs of circles B, B', C, C', D, D', of the same Article are

$$U = \{\lambda \sin r \cos (B - C) + \mu \sin r' \cos (C + A) \\ + \nu \sin r'' \cos (A + B\}^2, \quad (67)$$

$$U = \{\lambda \sin r \cos (B + C) + \mu \sin r' \cos C - A \\ + \nu \sin r'' \cos (A + B\}^2, \quad (68)$$

$$U = \{\lambda \sin r \cos (B + C) + \mu \sin r' \cos (C + A) \\ + \nu \sin r'' \cos (A - B)\}^2. \quad (69)$$

36. It can be seen precisely in the same way as in the analogous case on the plane (Art. 6), that the points of contact of three circles, S, S', S'', on the sphere with their four pairs of tangential circles are given by constructing the circles,

$$\frac{lS}{\cos r} = \frac{mS'}{\cos r} = \frac{nS''}{\cos r''}; \quad (70)$$

$$\frac{lS}{\cos r} = \frac{m'S'}{\cos r} = \frac{n'S''}{\cos r''}; \quad (71)$$

$$\frac{l'S}{\cos r} = \frac{mS'}{\cos r'} = \frac{n'S''}{\cos r''}; \quad (72)$$

$$\frac{l'S}{\cos r} = \frac{m'S'}{\cos r'} = \frac{nS''}{\cos r''}; \quad (73)$$

Also, that if A, A', A'', denote the radical circles of S, S', S'', taken in pairs, then the equations of the great circles passing through the points of contact on S, S', S'', are for the four pairs of tangential circles

$$\frac{A \cos r}{l} = \frac{A' \cos r'}{m} = \frac{A'' \cos r''}{n}; \quad (74)$$

$$\frac{A \cos r}{l} = \frac{A' \cos r'}{m'} = \frac{A'' \cos r''}{n'}; \quad (75)$$

$$\frac{A \cos r}{l'} = \frac{A' \cos r'}{m} = \frac{A'' \cos r''}{n'}; \quad (76)$$

$$\frac{A \cos r}{l'} = \frac{A' \cos r'}{m'} = \frac{A'' \cos r''}{n}. \quad (77)$$

37. Again, taking any pair of the circles S, S', S'', the four points of contact on it with any pair of the tangential circles (50)–(53) are concyclic; the equations of the circles passing through these concyclic points are, if we denote the determinants (50)-(53) by the notation ϕ_1, ϕ_2, ϕ_3, ϕ_4;

$$\frac{d\phi_1}{dS}=0;\ \frac{d\phi_1}{dS'}=0;\ \frac{d\phi_1}{dS''}=0; \tag{78}$$

$$\frac{d\phi_2}{dS}=0;\ \frac{d\phi_2}{dS'}=0;\ \frac{d\phi_2}{dS''}=0; \tag{79}$$

$$\frac{d\phi_3}{dS}=0;\ \frac{d\phi_3}{dS'}=0;\ \frac{d\phi_3}{dS''}=0; \tag{80}$$

$$\frac{d\phi_4}{dS}=0;\ \frac{d\phi_4}{dS'}=0;\ \frac{d\phi_4}{dS''}=0. \tag{81}$$

IV.

EQUATIONS OF THE CONICS IN PAIRS HAVING DOUBLE CONTACT WITH A GIVEN CONIC WHICH TOUCH THREE OTHERS ALSO HAVING DOUBLE CONTACT WITH THE SAME GIVEN CONIC.

38. The equations of the circles on the surface of a sphere that we have employed hitherto denote but one of the intersections of a cone with a sphere whose centre is at the vertex of the cone; thus, if α, β, γ, be three such circles, then, taking account of the complete intersections of the sphere with the cones, it is evident we get three other circles, which we may denote by α', β', γ'; thus we have

8 circles touching α, β, γ;
8 „ α', β, γ;
8 „ α, β', γ;
8 „ α, β, γ';

hence we have 32 circles in all.

The equation $S-L^2=0$, of a small circle on the surface of the sphere, given in Dr. Salmon's "Geometry of Three Dimensions," is the complete intersection of the sphere with the cone; and it is easy to see that its factors $S^{\frac{1}{2}}-L=0$ and $S^{\frac{1}{2}}+L=0$ are the separate circles which make up the complete intersection; in fact, taking the equation of any small circle on the sphere,

$$\text{Cos}\ r-\{\cos n\cos\rho+\sin n\sin\rho\cos(\theta-m)\}=0,$$

it is by transformation to three rectangular planes changed into

$$(x^2+y^2+z^2)^{\frac{1}{2}} \cos r = L,$$

where x, y, z, are the co-ordinates of any point in the circle, and L is the perpendicular from the same point on the plane of the great circle whose pole is the centre of the small circle; now, this equation is of the form

$$S^{\frac{1}{2}} - L = 0;$$

and it may be shown that the equation of its twin circle (see Salmon, page 200, foot note) is of the form

$$S^{\frac{1}{2}} + L = 0.$$

Hence the equation of the pair of circles touching three circles, α, β, γ, on the surface of a sphere may be written in either of the forms

$$\sqrt{\frac{l(S^{\frac{1}{2}}-L)}{\cos r}} + \sqrt{\frac{m(S^{\frac{1}{2}}-M)}{\cos r'}} + \sqrt{\frac{n(S^{\frac{1}{2}}-N)}{\cos r''}} = 0; \qquad (82)$$

$$\sqrt{\frac{l(S^{\frac{1}{2}}+L)}{\cos r}} + \sqrt{\frac{m(S^{\frac{1}{2}}+M)}{\cos r'}} + \sqrt{\frac{n(S^{\frac{1}{2}}-N)}{\cos r''}} = (4). \qquad (38)$$

And it will be seen that these, when cleared of radicals, give the same result; and the equations of the other pairs of circles are got from these by properly accenting l, m, n.

39. If S' S'', be two small circles of the sphere (fig. 7), $abcd$ a great circle passing through their centres, and J any circle cutting them orthogonally in a', b', c', d'; now, the anharmonic ratios of the four points, a', b', c', d', are equal to the anharmonic ratios of the points a, b, c, d; and two of the anharmonic ratios of the points a, b, c, d, are

$$\sin \tfrac{1}{2} ac \cdot \sin \tfrac{1}{2} bd : \sin \tfrac{1}{2} ab \cdot \sin \tfrac{1}{2} cd;$$

$$\sin \tfrac{1}{2} ad \cdot \sin \tfrac{1}{2} bc : \sin \tfrac{1}{2} ab \cdot \sin \tfrac{1}{2} cd;$$

and these are respectively equal to

$$l : \tan r' \cdot \tan r'';$$

$$l : \tan r' \cdot \tan r''.$$

Hence we have the following theorem:—

If any circle J cuts two small circles, S', S'', on the sphere orthogonally, two of the anharmonic ratios of the four points of section are

$$l : \tan r' \cdot \tan r'';$$

$$l' : \tan r' \cdot \tan r'';$$

.′, are the squares of the sines of half the direct and half the se common tangents of S', S''.

0. If the circles α, β, γ, be cut orthogonally by J, and denoting o of the anharmonic ratios (Art. 39) in which

J intersects β, γ by λ, λ',
J ,, γ, α ,, μ, μ',
J ,, α, β ,, ν, ν',

we have

$$l = \lambda \tan r' \tan r'',$$

$$l = \lambda' \tan r' \tan r'';$$

and substituting this value of l and corresponding values for m and n in equation (70), it becomes transformed into

$$\sqrt{\frac{\lambda(S^{\frac{1}{2}} - L)}{\sin r}} + \sqrt{\frac{\mu(S^{\frac{1}{2}} - M)}{\sin r'}} + \sqrt{\frac{\nu(S^{\frac{1}{2}} - N)}{\sin r''}} = 0; \qquad (84)$$

and the equations of the other pairs of circles are got from this by properly accenting λ, μ, ν.

41. In equation (84) it will be observed that λ, μ, ν, are anharmonic ratios, and that $\sin r$, $\sin r'$, $\sin r''$, are the results of substituting the co-ordinates of the poles of the great circles L, M, N, in the equations

$$S - L^2 = 0; \quad S - M^2 = 0; \quad S - N^2 = 0.$$

These considerations will enable us to write down the equations of the conics in pairs having double contact with the conic S, and touching the three conics

$$S - L^2 = 0; \quad S - M^2 = 0; \quad S - N^2 = 0.$$

42. Since the equations $S - L^2 = 0$, $S - M^2 = 0$, $S - N^2 = 0$, are the same analytically as the equations of conics having double contact with a given conic, we can, by means of Arts. 40, 41, write down the equations of the conics in pairs having double contact with a given conic, and touching three others also having double contact with the same given conic. Thus, corresponding to the system of circles α, β, γ, we have the conics

$$S^{\frac{1}{2}} - L = 0, \quad S^{\frac{1}{2}} - M = 0, \quad S^{\frac{1}{2}} - N = 0,$$

whose common chords are (see Salmon, page 228)

$$L - M = 0, \quad M - N = 0, \quad N - L = 0.$$

Let these chords (fig. 8) intersect in O; then from O draw pairs of tangents to the conics; then it may be proved—but I shall not occupy space in doing so—that the six points of contact, a, a'; b, b'; c, c', are in the circumference of a conic, and denoting two of the anharmonic ratios, as in Art. 40, of the points

a, a', b, b', by λ, λ';
b, b', c, c', „ μ, μ';
c, c', a, a', „ ν, ν';

and denoting the results of substituting the co-ordinates of the poles of the chords of contact L, M, N, in the equations of the conics $S - L^2 = 0$, $S - M^2 = 0$, $S - N^2 = 0$, by P, Q, R, respectively, we have from equation 84 the following system of equations of pairs of conics, each conic having double contact with S, and touching $S - L^2 = 0$, $S - M^2 = 0$, $S - N^2 = 0$:—

$$\sqrt{\frac{\lambda(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (85)$$

$$\sqrt{\frac{\lambda(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu'(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu'(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (86)$$

$$\sqrt{\frac{\lambda'(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (87)$$

$$\sqrt{\frac{\lambda'(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu'(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu(S^{\frac{1}{2}} - N)}{R}} = 0. \qquad (88)$$

43. The system of circles α', β, γ, have corresponding to them the system of conics $S^{\frac{1}{2}} + L = 0$, $S^{\frac{1}{2}} - M = 0$, $S^{\frac{1}{2}} - N = 0$; and denoting by $\lambda_1, \lambda'_1, \mu_1, \mu'_1, \nu_1, \nu'_1$, quantities analogous to $\lambda, \lambda', \mu, \mu', \nu, \nu'$, of the last article.

The common chords are $L + M = 0$, $M - N = 0$, $N + L = 0$; and the system of equations is

$$\sqrt{\frac{\lambda_1(S^{\frac{1}{2}} + L)}{P}} + \sqrt{\frac{\mu_1(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu_1(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (89)$$

$$\sqrt{\frac{\lambda_1(S^{\frac{1}{2}} + L)}{P}} + \sqrt{\frac{\mu'_1(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu'_1(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (90)$$

$$\sqrt{\frac{\lambda'_1(S^{\frac{1}{2}} + L)}{P}} + \sqrt{\frac{\mu_1(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu'_1(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (91)$$

$$\sqrt{\frac{\lambda'_1(S^{\frac{1}{2}} + L)}{P}} + \sqrt{\frac{\mu'_1(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (92)$$

44. The system of circles α, β' γ, have corresponding to them the system of conics $S^{\frac{1}{2}} - L = 0$, $S^{\frac{1}{2}} + M = 0$, $S^{\frac{1}{2}} - N = 0$; common chords, $L + M = 0$, $M + N = 0$, $N - L = 0$; and let the anharmonic ratios be

$$\lambda_2,\ \lambda'_2,\ \mu_2,\ \mu'_2,\ \nu_2,\ \nu'_2,$$

then the corresponding system of equations is

$$\sqrt{\frac{\lambda_2(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu_2(S^{\frac{1}{2}} + M)}{Q}} + \sqrt{\frac{\nu_2(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (93)$$

$$\sqrt{\frac{\lambda_2(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu'_2(S^{\frac{1}{2}} + M)}{Q}} + \sqrt{\frac{\nu'_2(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (94)$$

$$\sqrt{\frac{\lambda'_2(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu_2(S^{\frac{1}{2}} + M)}{Q}} + \sqrt{\frac{\nu'_2(S^{\frac{1}{2}} - N)}{R}} = 0; \qquad (95)$$

$$\sqrt{\frac{\lambda'_2(S^{\frac{1}{2}} + L)}{P}} + \sqrt{\frac{\mu'_2(S^{\frac{1}{2}} + M)}{Q}} + \sqrt{\frac{\nu_2(S^{\frac{1}{2}} + N)}{R}} = 0; \qquad (96)$$

45. The system of circles α, β, γ', have corresponding to them the system of conics $S^{\frac{1}{2}} - L = 0$, $S^{\frac{1}{2}} - M = 0$, $S^{\frac{1}{2}} + N = 0$; common chords, $L - M = 0$, $M + N = 0$, $N + L = 0$.

Let the anharmonic ratios be

$$\lambda_3,\ \lambda'_3,\ \mu_3,\ \mu'_3,\ \nu_3,\ \nu'_3;$$

then the corresponding system of equations is

$$\sqrt{\frac{\lambda_3(S^{\frac{1}{2}} - M)}{P}} + \sqrt{\frac{\mu_3(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu_3(S^{\frac{1}{2}} + N)}{R}} = 0; \qquad (97)$$

$$\sqrt{\frac{\lambda_3(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu'_3(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu'_3(S^{\frac{1}{2}} + N)}{R}} = 0; \qquad (98)$$

$$\sqrt{\frac{\lambda'_3(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu_3(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu'_3(S^{\frac{1}{2}} + N)}{R}} = 0; \qquad (99)$$

$$\sqrt{\frac{\lambda'_3(S^{\frac{1}{2}} - L)}{P}} + \sqrt{\frac{\mu'_3(S^{\frac{1}{2}} - M)}{Q}} + \sqrt{\frac{\nu_3(S^{\frac{1}{2}} + N)}{R}} = 0. \qquad (100)$$

46. We have in the last four articles given the equations of the sixteen pairs of conics having double contact with a given tonic, and touching three others also having double contact with the same given conic; and it is evident, from Articles 12, 14, 32, that Dr. Hart's theorem holds for each of the four systems into which we have written the equations.

47. It may be proved precisely as in Articles 7, 36, that the points of contact of the pair of conics given by the equation (85) with the conics $S-L^2=0$, $S-M^2=0$, $S-N=0$, are constructed by drawing the three lines

$$\frac{P(L-M)}{\lambda}=\frac{Q(M-N)}{\mu}=\frac{R(N-L)}{\nu}.$$

We give in the annexed scheme the entire system of forty-eight lines for the sixteen pairs of equations:—

1°. For the system of tangential conics (85)-(88) corresponding to the system of concurrent common chords

$$L-M=0\quad M-N=0,\ N-L=0,$$

the equations of the lines for constructing the points of contact are

$$\frac{P(L-M)}{\lambda}=\frac{Q(M-N)}{\mu}=\frac{R(N-L)}{\nu}; \tag{101}$$

$$\frac{P(L-M)}{\lambda}=\frac{Q(M-N)}{\mu'}=\frac{R(N-L)}{\nu'}; \tag{102}$$

$$\frac{P(L-M)}{\lambda'}=\frac{Q(M-N)}{\mu}=\frac{R(N-L)}{\nu'}; \tag{103}$$

$$\frac{P(L-M)}{\lambda}=\frac{Q(M-N)}{\mu'}=\frac{R(N-L)}{\nu}. \tag{104}$$

2°. For the system of conics (89)-(92) corresponding to the system of concurrent common chords $L+M=0$, $M-N=0$, $N+L=0$, the equations of the lines through the points of contact are

$$\frac{P(L+M)}{\lambda_1}=\frac{Q(M-N)}{\mu_1}=\frac{R(N+L)}{\nu_1}; \tag{105}$$

$$\frac{P(L+M)}{\lambda_1}=\frac{Q(M-N)}{\mu'_1}=\frac{R(N+L)}{\nu'_1}; \tag{106}$$

$$\frac{P(L+M)}{\lambda'_1}=\frac{Q(M-N)}{\mu_1}=\frac{R(N+L)}{\nu'_1}; \tag{107}$$

$$\frac{P(L+M)}{\lambda'_1}=\frac{Q(M-N)}{\mu'_1}=\frac{R(N+L)}{\nu_1}. \tag{108}$$

3°. For the system of conics (93)-(96) corresponding to the system of concurrent common chords $L+M=0$, $M+N=0$, $N-L=0$, of the conics $S-L^2=0$, $S-M^2=0$, $S-N^2=0$, the equations of the lines through the points of contact are,

$$\frac{P(L+M)}{\lambda_2}=\frac{Q(M+N)}{\mu_2}=\frac{R(N-L)}{\nu_2}; \qquad (109)$$

$$\frac{P(L+M)}{\lambda_2}=\frac{Q(M+N)}{\mu'_2}=\frac{R(N-L)}{\nu'_2}; \qquad (110)$$

$$\frac{P(L+M)}{\lambda'_2}=\frac{Q(M+N)}{\mu_2}=\frac{R(N-L)}{\nu'_2}; \qquad (111)$$

$$\frac{P(L+M)}{\lambda'_2}=\frac{Q(M+N)}{\mu'_2}=\frac{R(N-L)}{\nu_2}. \qquad (112)$$

4°. For the system of conics (97)–(100) corresponding to the system of concurrent common chords $L-M=0$, $M+N=0$, $N+L=0$, the lines through the points of contact are

$$\frac{P(L-M)}{\lambda_3}=\frac{Q(M+N)}{\mu_3}=\frac{R(N+L)}{\nu_3}; \qquad (113)$$

$$\frac{P(L-M)}{\lambda_3}=\frac{Q(M+N)}{\mu'_3}=\frac{R(N+L)}{\nu_3}; \qquad (114)$$

$$\frac{P(L-M)}{\lambda'_3}=\frac{Q(M+N)}{\mu_3}=\frac{R(N+L)}{\nu'_3}; \qquad (115)$$

$$\frac{P(L-M)}{\lambda'_3}=\frac{Q(M+N)}{\mu'_3}=\frac{R(N+L)}{\nu_3}. \qquad (116)$$

Hence we have a method of describing the sixteen pairs of conics.

In a subsequent paper I shall show that the greater number of the equations employed in this paper are capable of double interpretations, and also that the methods of demonstration employed can be used with advantage in other parts of geometry.

G. V. Du Noyer, Senior Geologist, G. S. I., M. R. I. A., presented the following collection of Drawings from original sketches of various antiquities, to form Vol. VII. of a similar donation to the Library of the Academy.

EARLY IRISH AND PRE-NORMAN ANTIQUITIES.

No. 1. Cromleac in the townland of Ballynageeragh, county of Waterford.

No. 2. Unfinished cromleac near Ballyphillip Bridge, Dunhill Glen, county of Waterford.*

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* For detailed description of these cromleacs and remarks on the classification of ancient Irish earthen and megalithic structures, see a paper, by the same writer, in the "Kilkenny Archæological Journal" for April, 1866.

3. Plan and restoration of St. Bridget's House, at Faughart, county of Louth.

This singular structure, which has been erected on a boss of rock near the old church of Faughart, was a simple dome-shaped stone hut or cloghaun, in plan resembling an elongated horseshoe, and measuring 12 ft. by 7 ft. 6 in. internally, the doorway, which was 2 feet in depth, being at the narrow end, and facing to the north-east. This building, of which nothing now remains but the foundations, evidently bears a close resemblance to the cell or house of St. Kevin which crowns the summit of the rocky knoll over the Reafert church at Glendalough—a structure erected by St. Kevin himself, according to the life of that saint published by the Bollandists.*

In Vol. IV. of a donation similar to the present I have given a plan of the house or cloghaun of St. Gobbonet at the old church of Ballyvourney, county of Cork, erroneously marked on the Ordnance Survey Map as "Base of Round Tower," which, though larger than that of St. Bridget, is of the same type; and in Vol. V. of the same series I give a view of the house or church of St. Finan Cam, from the Church Island, in Waterville Lake, county of Cork, which is also a structure of the cloghaun type.

It is noteworthy that, according to the six lives of St. Bridget, attributed to as many ancient authors, and published by Colgan, it appears that she was born at Fochard (now Faughart), in the county of Louth, some time in the middle of the fifth century; and, after passing a life of celibacy and piety, and in 480 having founded the religious establishment at Kildare, she died there about the year 523.

Irish archæologists will have no hesitation in accepting the truth of the local tradition which asserts, that this stone hut was used by St. Bridget as her cell or house, and the restoration as I have given it is correct by analogy.

No. 4. Base of the Round Tower at St. Endeus, or Enda, pronounced by the people on the spot Eanagh, on the Island of Arranmore, in Galway Bay. The inhabitants of the village of Killeana, which lies at the base of the rise of the hill on which this tower stood, stated that when the tower was perfect they could see across the island to the south from the top of it, and that it was built to *hold the bell* of the neighbouring church. From this we are not to infer that the bell was suspended, and swung in the tower as in a campanile; but that the tower was used as the repository of this valued sacred property, amongst other appliances for which it would be suitable. My late lamented friend Dr. Petrie, for whom not one who knew him had more sincere feelings of affection than myself, told me that he recollected seeing this tower perfect to the height of about twenty feet, and that he had conversed with old people on the island who recollected seeing it over eighty feet in height, and some of the upper opes perfect. When I visited the island in the summer of 1847, I could see but five courses of the masonry.

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* See Petrie's "Essay on the Round Towers," p. 424.

No. 5. Interior of the window in the south wall of Kilmacduagh, or the church of St. Colman Mac Duagh at Kilmurvey, on the same island. This church was erected for St. Colman Mac Duagh by his kinsman, Guaire Aidhne, King of Connaught, about the year 610.[*] The flat-pointed head of this ope, and its small proportions externally, are quite in keeping with other structures of this class, as well as with similar features in some of our earliest Round Towers.[†]

No. 6. Another window, from the south wall of the nave of the same church.

No. 7. Interior of St. Kevin's Church, on the southern of the Islands of Arran, called Inisheer.[‡] The view is taken looking under the choir arch to the doorway in the west gable. The masonry of this church is purely Etruscan, or, as it has been called, Cyclopean. The doorway is flat-headed, with converging sides; the choir arch is quite plain, but the imposts from which it springs are perfectly unique in the style of their decoration. Their ornamentation resembles a row of short drooping feathers, without the usual terminal moulding or bead. As well as I remember, this arch is semicircular, and it is interesting to find such a feature in connexion with the flat-headed Etruscan doorway. Our Lady's Church at Glendalough is another example of the occurrence of the semicircular and flat arch in the same building.

No. 8. Interior view of the small loop or window in the south wall of the choir of the same church. Without doubt, this building may date to the seventh century.

No. 9. The four grotesque masks carved over each of the windows at the summit of the Round Tower on Devenish Island and the associated decorative carving on the string course over the windows, and just below the springing of the conical roof of the tower.

Nos. 10, 11, 12. Three views of a sculptured granite plinth of a cross, from near the old castle of Ould Court, county of Dublin. I know of no better example in Ireland showing how decorative carving is modified in its character by the materials used, than in this instance. The designs are boldly and simply produced without any attempt at details unsuitable to the roughness of the material. These consist of figures of men and animals, brought to relief by sinking the field of the stone around them, and were doubtless suggested by some prominent events during the life of the patron saint of the place, or the king of the district. One side of the plinth bears a human figure standing erect, and battling with rampant animals, one on either side of him; the device below this I cannot unravel. Another side represents two animals like horses, with their necks and fore legs crossed, as if fighting, while two men stand by, one in the act of bending forward as if to separate the animals, and the other standing erect, enveloped in a cloak. Below this is a single hunter with two dogs running before him, and each trying to catch a long-billed bird like a pelican, which is represented in the act of running, and not flying away from its pursuers. The third face has its upper compartment divided into an arcade of four arches, under two of which are human figures, face to face, as if conversing; and beneath the two other arches is a man on horseback trotting away from the conference; below this are two animals like horses facing each other, and looking down on a triquatra ornament, while over one of the horses is a human mask.

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[*] Guaire Aidhne, King of Connaught, lived at Gort, which was anciently called Gort Insi Guaire, or the Field of Guairie's Island.—W. M. Hennessy.

[†] See Petrie's "Essay," p. 176.

[‡] The origin of the form *Inisheer* has not yet been explained. It is this:—The ancient epithet was *Iarnairther*, as may be seen from a passage in the "Book of Invasions" (A. D. 856), where the expression "o Dun Cermna co hArainn *Iarnairthir*" occurs. In the parallel entry the "Four Masters" call it simply *airther*. Now, if we compare the form *iartuais-cerddach* (gl. etesiarum, z. 777) with the same word glossed *euro aquilo* ("Book of Armagh," 188, b. 2), we shall find that *iarnairther* means *south-east*. In this formula *iar* expresses a position *after* the cardinal point with which it is connected, and before the next cardinal point, reckoning sunwise. Comp. the Lat. *post-meridianus*, *post-autumnalis*, &c. Thus *iartuais-cerddach* will mean *north-east*, and *iarnairther*, south-east; but this *iarnairther* having become unintelligible, *airther* was omitted; and thus we have *Ara Iar*, or *Inis Iiar* (hodie *Inisheer*).—J. O'B. Crowe.

It is not easy to assign a date to this work, which however, from the truncated pyramidal form of the plinth, and the shortness and plumpness of the human figures, may very possibly date back to the tenth or eleventh century.

No. 13. Exterior view of the east window of St. Fingin's Church at Clonmacnoise—a building possibly of the early part of the twelfth century.*

No. 14. Exterior view of the lowest ope of the Round Tower of St. Fingin's Church, Clonmacnoise.

No. 15. Do. of the second window from the basement of the same tower.

Nos. 16 to 25. The following ten illustrations are taken from the sculpturings on the cross at Clonmacnoise known as that of King Fland, according to the "Annals of the Four Masters," and an inscription in the Irish character on the plinth of the cross, now unhappily defaced by time.

The first illustration which I have selected is taken from the lowest compartment on the east face of the cross; it represents King Fland and the abbot Colman Conaillech, who together founded the Church of the Kings in A.D. 909, making a compact by swearing on the cross or pastoral staff of the saint. The costume of the king is exceedingly interesting; his head is covered by a flat and bordered close-fitting cap, from beneath which the hair falls behind over the shoulders in a massive club, ending in a ball; and over the ears there is a globose ornament, which is possibly attached to the skullcap; the moustache is heavy and plain, and the beard is long, and plaited to a point; the arms and legs are bare; and the body is clothed in a tunic which reaches no farther than above the knees, where it is bordered by a row of small disks below a zigzag ornament; a broad strap is suspended over the right shoulder, and joins on to a waistbelt, into which is thrust a broad and short sword with a plain crossguard, and a very massive semicircular pomell, quite resembling in outline those iron swords said to be Danish, and which were found in the old burying ground at Bully's-acre near Islandbridge, Dublin. From the evidence afforded by the sculpturings on most of our tenth, eleventh, and twelfth century decorated crosses such swords are clearly Irish, though others similar in shape were no doubt used by the Danes during the lengthened period they held possession of Dublin and the eastern coast of Ireland.

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* Petrie, p. 269.

The figure of St. Colman represents him as a young, smooth-faced man, attired in a round, narrow-rimmed hat; a short cloak with a large hood hanging behind; a long gown reaching to the ankles, and fringed with a row of disks between two narrow bands; and his feet are probably bare.

The cross is covered with the veilum, or scarf, and, with the staff, reaches to the full height of the figures, which grasp it with the right and left hands alternately.

No. 17. The next illustration affords a still further insight into the regal and secular costume of that period. It represents King Fland, who can always be recognised by his broad plaited beard, standing on the right hand side of another king or chieftain, and joining hands with him. On this occasion the king is enveloped in a long mantle, bordered by pellets, and fastened on his right breast below the shoulder by a large fibula, pierced with four circles to form a cross; the lower portion of the figure is enveloped in a long garment, reaching to the ankles, and belted round the waist; the sword belt is thrown over the left shoulder outside the cloak, and the sword hangs in front over the cloak, as if ready for immediate use. The adjoining figure to the left of the king is, like him, bare headed, with the hair curled over the ears; the moustache is heavy, with the ends curled up, the beard is bi-forked, with the ends curled up like those of the moustache; his dress is in all respects similar to that of the king, but that a portion of the inner garment is looped up in front and caught by the waistbelt, so as to form a sort of philibeg; the sword is exterior to the cloak, and is either attached to the waistbelt, or held naked in the left hand, just below the crossguard—the latter being the most probable explanation.

It would appear that the sculptor miscalculated the length of the space to be occupied by the figures, and was obliged therefore to omit the feet of both effigies.

No. 18. This and the following four illustrations, no doubt, record some remarkable events in the life of King Fland, and I thus venture to explain them:—

There came up the Shannon to visit the court of King Fland, at Clonmacnoise, a wandering minstrel from Greece, or perhaps from Rome; his special instrument was the triple flageolet, and he played before the king and his assembled courtiers; the tones which he produced by much physical effort, as his inflated cheeks and swollen eyes attest, though pleasing to himself, were by no means appreciated by the Irish audience; and the witty sculptor, while he recorded the remarkable fact of the advent of the foreigner, satirized his performance by likening it to the squalling of two cats tied together by the hind legs and tails; while the lower notes of the flageolet resembled such unheard-of tones as might be produced by a learned animal of the canine species, if he could convert his own body into a bagpipe, and make his tail the chanter. The dress of the musician is quite unlike any costume I have seen on any of our sculptured crosses; it consists of a simple long robe, reaching to the feet which are bare; the sleeves very wide at the elbow, but closely confined at the wrists; the hair is divided at the forehead, and falls long and straight down the back from one shoulder to the other.

No. 19. It would appear that at this time the court of King Fland was graced by the presence of a female harpist of much grace and beauty; she is here represented as seated with her harp on her knee; she is clothed in a long flowing dress, reaching to the ankles, and a short cloak, the hood of which is modestly brought round the face, and hangs in a graceful curve down her back. Her performance must have been of the highest order, and the whole expression of the figure conveys the idea that the last chord of some thrilling melody has just been struck, and the performer looks round for the accustomed applause. So effective were the melodies of the harpist, that the spirit of *ennui* and discord, typified by a crouching big-headed, horned monster, with its tail abjectly rolled up along its flanks, is placed beneath this figure which tramples upon it.

No. 20. In the compartment over the harpist we have another effigy of St. Colman, but seated, as forming one of the audience at the court concert; his right hand grasps a short cambutta, or pastoral staff, with a crooked head; a short scolloped mantle envelopes his shoulders, and directly over his head is a cherubim with expanded wings.

In this sculpturing, I think, we have expressed the delight of St. Colman at the performances of the female minstrel, which to his poetic imagination resembled the voices of an angelic choir.

Here I must pause for a moment, to remark that till I saw this sculpturing I had but little respect for a cherubim, as I classed it with the *cinque cento* and Rococo ornaments of the Elizabethan era: here, however, we can trace its pedigree back to the ninth or tenth century, and we find it associated at that time with the saints and magnates of the land.

No. 21. In this sculpturing we have St. Colman seated in an arm chair: in his right hand he holds his large cross, and with the end of it he strikes the face of a prostrate figure, apparently clothed in no other garment than a short mantle. Can this represent the punishment or expulsion of some offender from the court of King Fland? for the scene is too circumstantial to be merely allegorical.

No. 22. Here we again see King Fland and his companion (as illustrated in Fig. 17), each being identified, the one by his plaited beard, and the other by his heavy curled-up moustache. St. Colman is seated between them in conclave, as if urging them on to some joint mode of action; in his right hand the saint holds the short cambutta with the crutch head, formed by a double crook which appears to have been the third kind of ecclesiastical staff used by the early Irish bishops, and of which we find many examples on our sculptured crosses and illuminated MSS.; this he holds towards the figure opposite King Fland, who grasps it with his right hand, the saint extending his left hand to the king, and presenting to him something like a small box; but this portion of the carving is very obscure.

In the foregoing two illustrations we no doubt have representations of some remarkable event in the life of King Fland.

No. 23. This sculpturing appears to represent the guarding of the sepulchre, and the ascent of our Lord—the Roman soldiers being, of course, dressed in the costume and with the arms of the Irish gallowglass of the ninth and tenth centuries; these consist of a conical helmet, a short stout spear, a belted tunic reaching to just above the knees, the arms and legs being bare; neither figure is bearded, though the moustache is worn, which may either imply that the men were young, or that the beard was not allowed to the common soldier, which is, I think, the most correct explanation.

Over the head of the small central figure is the *nimbus*, and above it a circle with a descending dove within it, typifying the Holy Spirit; and to this subject I shall presently return.

No. 24. This sculpturing is obscure in its meaning, and is merely given as affording another example of the arms and costume of the gallowglass, which agree with that just noticed.

No. 25. Sculpturing on the soffit of the circle of the cross; it represents two human masks inclosed by two serpents wound together in an S-shape form; and it is quite evident that the sculptor drew on his imagination for the figures of the serpents, as he appended ears to them like those of a ruminant, and a spreading fantail like that of the salmon and perch. Above this device is an extended hand, *coupé* at the wrist, and surrounded by a circle, decorated, like the bodies of the serpents, with a row of small disks.

I have seen it stated that in the Greek or Eastern Church the bishop gives the benediction by extending the outstretched hand. Can we suppose, therefore, that the outstretched hand in this as well as in other similar examples is emblematic of the benediction bestowed on the cross when it left the hands of the sculptor?

No. 26. The sketch on the right hand side of this sheet represents the dove and *nimbus*, described as surmounting the head of our Lord in the sculpturing numbered 23; and to this feature I wish to direct your special attention, inasmuch as I believe that here we have the original idea which suggested the cross formed by the intersection of four parts of circles, or the cross of eight points which is essentially both Irish and Greek. By the side of this figure I give the cross derivable from it, and which I propose to call the dove cross.

In the following illustration, No. 27, this cross, in combination with that having straight arms, gives us the typical form of the Irish standard cross.

On the tombstone of Luguaedon Mac Clmenueh, the nephew of St. Patrick, figured by Dr. Petrie in his work on the Round Towers, this fanning or spreading out of the arms of the cross is expressed by the bifurcation of the straight arms of the cross. On many of our early ogham pillar stones we have the cross of eight points, and we possess an instance of this kind in our own collection of antiquities.* In such standard crosses as that of St. Nen, or Nenidius, on Inishmacsaint Island in Lough Erne, figured in Vol. II. of this series, we have this form of cross, but without the circle or aureole, which was not essential in its true character. When, however, the dove cross is surrounded by the aureole or circle, with the straight-armed or Latin cross projecting beyond it, as in Fig. 27, the cross attains its full development, and typifies the Divinity as well as the humanity of our Lord.

I had long sought for the origin of the cross and circle, as seen on our monuments, and I believe that I have found it in the figure of the outstretched dove from the cross of Clonmacnoise.

No. 28. The dove is frequently sculptured on our decorated crosses, as emblematic of the Holy Spirit. Thus, in the example now given, from the shaft of the headless cross in the graveyard at Kells, in the county of Meath, which represents the baptism of Christ, the bird appears in the act of alighting on one of the bulbs of the water lily placed beneath the male figure as emblematic of river water.

Nos. 29, 30, 31. Ancient tomb slabs from Clonmacnoise; the churchyard of Kells, county of Meath; and the old abbey in the demesne of Castle Archdall in the county of Fermanagh. These three examples of early Christian tombstones are all remarkably alike, and exhibit the cross of eight points, or the dove cross inclosed in the circle, thus showing how similar and how widespread over the island was ecclesiastical taste in such matters.

No. 32. View of the stone-covered holy well called Tobar-na-Druad (Well of the Druidess),† or Clon Tubrid (Retreat of the Well), in the county of Kilkenny, from a sketch kindly supplied to me by the Rev.

called Labba Mollogga in the county of Cork, (see Vol. V. of this series), now figured

No. 34. And the third I have already illustrated in connexion with the details of the old church of Kilmalkedar in the county of Kerry, Vol. V. of this series. The occurrence of stones carved in this peculiar form in places so remote from each other is somewhat remarkable, and there must have been some peculiar meaning attached to them, with which we are at present not acquainted. At Kilmalkedar I was informed that this heart-shaped stone was originally placed on the apex of the west gable, and that it was thrown down in a storm; it is quite possible that this was the original purpose for which these stones were intended, and, if so, we have discovered the correct device for the completion of the west gable of churches up to the early part of the twelfth century at least, a point in early Irish ecclesiastical architecture hitherto undefined.

No. 35. Exterior view of the doorway of the old church of Clonamery, or Killamery in the county of Kilkenny, from a sketch by the Rev. James Graves. This doorway, which is flat-headed, with converging sides, is strictly Etruscan in its style of masonry; it is surrounded by a raised broad flat band, which does not appear to have been completed down the lower half of the southern jamb of the door; from the upper part of this band, where it crosses the lintel, a broad flat moulding projects vertically across the lintel, and joins on to a cross of eight points (the dove cross), also flat, but in relief, and carved on the adjoining stone.

From the general similarity of this doorway to that of the old church of St. Fechin's at Fore, in the county of Westmeath, figured in Vol. VI. of this series, and also to that of the Round Tower of Lusk, in the county of Dublin,* we are safe in assigning the date of this doorway to the seventh or eighth century.

No. 36. Plan of the doorway of the old church of Killeshin, in the Queen's County, near Carlow.

No. 37. Engraved ornament, drawn to the full size, on the soffit of the inner arch of the doorway of Killeshin old church.

No. 38. Decorations at either side of the jam of the doorway of the same old church.

No. 39. Engraved ornament on the soffit of the outer arch of the doorway of the same old church.

No. 40. Exterior view of the window in the north wall of the same old church. This ope, which is of slender proportions, and semicircular-headed, is surrounded by a remarkably broad and projecting flat moulding, terminating in a flat-sided pointed arch, cut out of one stone. The inner eastern edge of this band has been cut, for a portion of its length, into a round pilaster, without a cap or base—thus showing that the decorations of the window were never completed, and assisting to prove in a remarkable manner the truth of the historical fact recorded of this church, that the architect quarrelled with the founder, and left the building unfinished.†

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* See Vol. IV. of this series.

† See "Annals of the Four Masters."

No. 41. Plan of Killeshin old church.

No. 42. Plan of the old church of Maghera, county of Derry.

No. 43. Details of the mouldings of the doorway and east window of the old church of Maghera, county of Derry.

No. 44. Plan of the priests' house attached to the old church of Maghera.

No. 45. Interior view of the choir and east gable of the old church on Holm Patrick, Skerry Island, Skerries, county of Dublin.*

This structure, which is probably of the twelfth century, or early in the thirteenth, has the choir stone-roofed and groined, being pierced at the east end by two semicircular-headed windows, so far apart as to allow a narrow semicircular-headed niche between them. All the window casings, as well as the quoins of the main building, are of calc tufa—a material sometimes used in the construction of twelfth and thirteenth century churches, as in the roof of Cormac's Chapel at Cashel. This stone, from its porosity, is remarkably light, and from its exposed position at this locality is externally decayed, though singularly sound, all circumstances considered.

No. 46. Exterior view of the window of the north wall of the chancel of the same church.

No. 47. Plan of the same old church.

No. 48. Exterior view of the doorway in the west gable of the old church of Clone, in the county of Wexford, near Ferns.

As in the doorway of the old church of Maghera, we have here a fine example of the transition style of church architecture between the eleventh and thirteenth centuries. The form of the outer portion of the door is essentially ancient, while the surrounding moulding, with the surmounting semicircular arch, is clearly in the style of the thirteenth century. We have now no means of judging what was the exact character of the external arch; it was, however, formed of stones not bonded into the masonry of the gable, and in this respect resembled the arch over the doorway of the Round Tower of Dromiskin, near Dundalk.† We know, however, that the arch was decorated round its outer margin by five human heads, four of which are still *in situ*, the fifth being placed over St. Edan's Well, opposite to the present parish church of Ferns. The head at the crown of the arch is that of a bishop or mitred abbot; lower down, on the north side, is the head of the king or chieftain; and on the opposite corresponding side that of the queen, or wife of the chieftain: at the springing of the arch, on the north side, is the head of what we may suppose to be the architect, and which is now to be seen over St. Edan's Well; and at the corresponding side is a grotesque face, and on the stone next above it is the figure of a short-tailed dog. We may suppose this portrait to be that of the court jester, the local Yorick of his day, and possibly the master of the hounds.

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* During a recent visit to Holm Patrick, I found with regret that the groined roof of the choir had fallen in, and a roughly constructed cattle shed, or possibly a dwelling place, had been erected out of the materials forming the west gable and part of the side walls of the church. From wanton destruction and neglect, this interesting remain will soon be a shapeless mass of ruins.

† See Vol. III. of this series.

No. 49. Interior view of the same doorway, showing the presence of a relieving arch at the inner surface of the gable.

No. 50. Sketch of a smooth block of finely porphyritic Diorite, lying on the rise of ground close to the old church of Clone. This block bears in delicately incised lines the cross of eight points formed by the intersection of four parts of circles, and inclosed in a circle. The presence of such a cross as this on a smoothed boulder proves the fact, that the site of Clone church was selected for a religious establishment many centuries before the present structure was erected—indeed, most probably during the life time of St. Edan, who died in the seventh century.*

No. 51. The ancient font at Clone church, which is undoubtedly of equal age with the cross just described. This rude vessel is cut out of a block of greenish trappean ash, and resembles in general character those frequently found attached to some of our oldest churches, and called *Bullauns* by the peasantry of the South and West of Ireland.

ANGLO-NORMAN ANTIQUITIES AND ARCHITECTURE.

No. 52. Effigy in chain mail from the nave of Christ Church Cathedral, Dublin. Till lately this knightly effigy was supposed to be that of De Clare, Earl Strongbow, who died at the close of the twelfth century; but, as I have long ere this stated, the occurrence here of the rowelled spur is strong evidence against its being a work of the twelfth century, the earliest example of a spur of this form, according to Planché, being first observed on the seal of Henry III., 1216.†

The Rev. James Graves, in a most admirable memoir on this effigy, lately published in "The Gentleman's Magazine," has shown conclusively that the coat of arms displayed on the shield of this effigy, viz., in chief, three crosses, pattee, fitchée, are not those of the De Clare family, Earls of Pembroke, their arms being either three chevrons, or chevronée. Which of the Norman knights is here pourtrayed has therefore yet to be determined. I need not describe the armour further than to remark that the knee caps of plate—*genouilitieres*—with the close-fitting "chapeau de fer," indicate a change from the pure or unmixed mail, to the plate armour of Italy.

No. 53. Side view of this effigy, showing the armorial bearings on the shield.

No. 54. Carving on a small slab of sandstone, sixteen to eighteen inches square, from the old church of Annagh, county of Kerry, representing a knight on horseback, standing in his stirrups, with both arms extended, the right hand holding the sword, as if leading on his followers to battle. This is evidently a work of the twelfth century at the latest, as is proved by the presence of the spike spur, which is not fastened to the heel, but strapped round the ankle. The form of the crossguard of the sword is also twelfth century; and it is singular that the figure is accoutred without a scabbard. The form of the helmet is obscure, owing to the upper portion of the head having been broken away. The body is clothed in a surcoat reaching to below the knee in massive plaits, the waist is belted. The saddle is peaked in front and rear, reaching high above the waistbelt; the shoulders and the greater part of the neck of the horse are protected by a thick tight-fitting covering, fastened to the bow of the saddle, the forehead of the animal being guarded by a rectangular plate of metal, apparently fastened to an inner neck-and-headguard, passing beneath the shoulder armour just described. There is the appearance of a bit in the horse's mouth; and the bridle, which is represented as single, passes beneath the neck armour. It is probable that this sculpturing formed a portion of a tomb erected to one of the Irish chieftains who fell in battle against the English invaders, or an equally hated neighbouring chieftain, as it is not at all probable that an English or Anglo-Norman knight would have acquired such a social standing as this tomb would indicate in such a remote district as this to the west of Tralee, at the close of the twelfth century.*

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* For a notice and illustration of the old church and Round Tower of St. Edan, see Vol. VI. of this series.

† See "Journal of the Archæological Institute" for June, 1845, memoir by the writer on the cross-legged effigies at Cashel, county of Tipperary.

No. 55. Effigy of St. Christopher, from a carving in high relief on limestone, preserved, when I saw it, in the Pilltown Museum, and stated to have been taken from Jerpoint Abbey. The saint is here represented as standing in the water, leaning on his budding staff, which is grasped in his right hand, while he bears the infant Saviour on his left arm and shoulder; the water is expressed by zigzag lines crossing his legs, and the lower end of the staff; and also by the outline of a fish on the field of the stone to the left of the figure. The cap of St. Christopher, which has a low round crown and a broad upright rim, is the only characteristic feature in the costume, and it fixes the date by the carving at the thirteenth century. St. Christopher's hair falls in flowing curls over his shoulders; his face is without the moustache, but he wears a carefully curled beard beneath his shaven chin. His body is clothed in a long-sleeved garment, the ends of which are looped up, and thrown over his left arm; beneath this is a loose tunic reaching to the knees. The head of the infant Saviour is surrounded by the *nimbus;* and his right hand and arm are raised in the act of giving the benediction to St. Christopher.

The legend of St. Christopher is one of exceeding quaintness, and contains a sound moral; and, as it is not generally known, I venture to give its leading facts, extracted from an admirable paper on this subject by Messrs. Dennet and Barton, of the Isle of Wight, and published in "The Archælogical Association Journal" for August, 1847, as explanatory of a mural painting discovered atShorewell Church in April, 1847. The authors take for their authority Caxton's edition of "The Golden Legend," printed in the year 1483, and translated by him from Jacobus de Voragine.

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* See notice of this effigy in the "Kilkenny Archæological Journal," vol. ii., part 2, 1853, p. 39, by Richard Hitchcock, Esq.

"St. Christopher was of right great stature, with a terrible and fearful countenance, and he was twelve cubits in length. He was in the service of the king, but it came into his mind that he would seek the greatest prince, and him only would he obey." Accordingly, he travels till he comes to one sovereign who is renowned as the greatest in the world; in his service he stays till upon a time a minstrel "song to fore him a song in which he named the devil oft;" and the king, which was a Christian man, when he heard him name the devil, made anon the sign of the cross. Christopher asks the reason of this; and, on learning that it was to protect him from the power of evil, concludes that the devil is mightier far than the king, whom he therefore leaves, saying, "I will go to search him [the devil] to be my lord, and him will I serve."

In journeying over the desert he meets a great company of knights; and one of them, with a cruel and horrible countenance, tells him that he is the power he seeks. They journey on till they come to a cross; and the devil, in sore affright, leaves the direct road in which it stands. This excites Christopher's curiosity, who, discovering the true reason for this fear, exclaims, "I have laboured in vain; I will serve thee no longer, for I will go seek Jesus Christ."

He travels then into a desert, and meets a hermit, who instructs him in Christianity, and ultimately places him beside a rapid river, where many perish who try to cross it, to bear over travellers harmless, because he is of gigantic stature and strength. Christopher then bare a great pole in his hand, instead of a staff, by which he sustained him in the water; and bare over all manner of people without ceasing.

One night, as he slept on his bed, he heard the voice of a child calling him. Then Christopher "lyft up the child on his shoulders, and took his staff, and entered into the ryver for to passe;" and the water of the river rose more and more, and the child was heavy as lead; and alway he went further, the water increased, and the child more and more waxed heavy, so that Christopher had great anguish, and was afraid to be drowned." When he had escaped to the other side, he set the child aground, and said, "Thou hast put me in great peril; thou wast almost as I had all the world upon me." And the child answered, "Thou hast not only borne all the world, but thou hast borne Him that made all the world, upon thy shoulders. I am the Christe the King, to whom thou servest in thy worke." And, as a token of the truth, he tells him that, if he sets his staff in the earth by his house, it shall grow; and when he arose in the morning, he found his staff like a palmyer tree, bearing flowers, leaves, and dates.

Christopher now travels to Lycia, and converts many by the exhibition of this miracle, until the king condemns him to death. He was accordingly bound to a strong stake, and forty archers were ordered to "shotten him through with arrows." None of the knights, however, might attain him; for the arrows hung in the air around him. Then the king, thinking that he had been executed, went towards him, when one of the arrows turned suddenly in the air, and smote him in the eye, and blinded him. Christopher tells him he may recover his sight by mixing his blood with clay, which, after the decapitation of the saint, he does, and recovers.

The writers go on to say that figures of St. Christopher are not uncommon, either painted on the walls or on glass, in churches. It was a popular superstition, common to all Catholic countries, which induced people to believe that the day on which they should see a figure of this saint they should neither meet with a violent death, nor die without confession. The Squire, in Chaucer's "Canterbury Tale," wore "a christofre on his breast of silver sheen," for the same reason.

At the lower compartment of the fresco painting, on the right side, St. Christopher is represented *as alive, and bound naked to his own staff, which resembles a budding tree; and his body and legs are pierced with innumerable arrows, shot by two archers, who stand one at either side of him.* This is one way of illustrating the miracle that he was not killed by being so pierced. In the distance the king is seen standing looking on at the execution, attended by his *sword-bearer* and *hawker*; and one of the arrows is represented as striking him in the eye.

In the year 1847 I visited Knockmoy Abbey, in the county of Galway, and sketched the fresco painting on the north wall of the chancel, which is familiar to all Irish archæologists, and to which allusion is made in "The Dublin Penny Journal;" and in a short memoir, by the Rev. Dr. Todd and Professor O'Curry, in the "Proceedings of the Academy" (vol. vi., p. 3); and, lastly, in the first volume of Sir W. Wilde's "Catalogue of the Academy Museum" (p. 315).

The lower compartment of this fresco painting represents *a living naked figure bound to a palm tree, and pierced in the body and legs with many arrows, shot by two archers, one at either side.* In the Catalogue of the Academy this painting is called the Martyrdom of St. Sebastian —an idea which is merely a repetition of a previously expressed opinion of Dr. Todd, who, in conjunction with Mr. O'Curry, detected the date (1400) in a black letter inscription on a portion of the painting alluded to. Any one conversant with the costume prevalent during the reign of Richard II.—1377 to 1399—would assign the date of the fresco painting to the close of the fourteenth century—an idea happily confirmed by the discovery of the date upon it.

With all respect to the two high authorities just named, I must disagree with them in believing that the Knockmoy figure represents the martyrdom of St. Sebastian. Without doubt it represents the martyrdom of St. Christopher, as is almost proved by the fact that the figure is represented as alive, and bound to a *budding tree*, the miraculous staff of the saint.

In all the representations of the martyrdom of St. Sebastian which I have seen, the figure is represented as in the last gasp of life, and seated on the ground, or in the act of falling from a standing position.

Dr. Todd, in the notice alluded to, states that the name of St. Sebastian does not occur in the Martyrology of "The Four Masters."

From the foregoing remarks, I think, we may safely conclude that the martyrdom of St. Christopher is the subject of the lower compartment of the Knockmoy fresco.

No. 56. Inscription in Anglo-Norman letters, from the wall of the episcopal castle of Fethard, in the county of Wexford, drawn to the full size. My friend the Rev. James Graves, to whom I am indebted for having brought me to see this inscription, sent me a sketch of it in the year 1863, informing me at the same time that a sculptured cross, standing in the courtyard of Carerew Castle, in Pembrokeshire, bore an inscription so similar to this as to lead to the belief that they must have been copied from the same MS. transcript. He stated that it never had been deciphered, and asked a reading of it. I believe it may be translated as follows:—

Maᵹ : (contracted) : "Magistère," or the major domo of the castle.
ᵹiꞇ : Lies
Eci : (phonetic) Here.
Ꞇꞃe : (contracted) : Tréfoncier. The proprietor of the estate.
Ceꞇ : This.
Ꞇ : Tombstone.
f& : Fecit, or Fecerunt.

This reading attempts the solution of a problem hitherto unsolved, and would be accepted by some of my antiquarian friends if I could account for the occurrence of a similar inscription on the Carerew cross. This I think is not just, as I have nothing to say to the cross in question, and know not what connexion there existed between the Anglo-Norman proprietor of the domain of Fethard in the twelfth or thirteenth century, the supposed date of the inscription, and the owner of Carerew Castle at the same period.

No. 57. Inscription in debased Anglo-Norman characters, from a slab set into the south sidewall of the chancel of Christ Church Cathedral, Dublin. It is remarkable that, though each letter of this inscription is perfect, and each word defined by three dots, no person to whom I have submitted it has attempted to read more of it than is evident to any one. I doubt that it is older than the sixteenth century, from the form of the letters A. N. and T., and the frequent joining together of the letters A. M. and A. R., which is so characteristic of the period to which I allude.

The name ION . . LUMBARD is very plain at the beginning of the inscription, and the second line comprises the words DE ⁝ PARME ⁝ E ⁝

DAME ⋮ RAME ⋮ PERIS ⋮ followed by DE ⋮ SEIDT ⋮ SAVMDVR ⋮ which in sound resembles *de Saint Saviour*, the last words being MURUNT ⋮ GIEINT ⋮ 1011, possibly meaning *having died, lies here.* The last four letters are obscure; for they could not possibly represent the date 1011 in Arabic numerals. The Rev. James Graves thinks the inscription is in Italian, which is quite possible.

No. 58. View of the Anglo-Norman tower erected at the extremity of the Hook promontory, county of Wexford.

This magnificent structure has been converted into a lighthouse, by the addition of a small circular turret, surmounted by the lantern—a purpose for which I have very little doubt the tower itself was originally constructed.

The main tower, which is about 70 feet in height, is circular without, but square within, the intervening spaces being occupied by a winding staircase, and small rectangular rooms leading off the central vaulted apartments. It is stated that De Courcy was the builder of this tower.

All history and traditions assert that Earl De Clare or Strongbow landed in 1170 or so, on the shore of the Waterford estuary, and according to the latest authorities, at Crook, opposite to Duncannon.

To the north of Hook, at Bag-in-bun Head, an earthen fosse and mound, which span the promontory from shore to shore, are pointed out as the site of Strongbow's entrenchment, and a rectangular depression in the sod, the place where his tent was pitched. I have no doubt that this spot was occupied by the Anglo-Normans at the time of their invasion, who found there an ancient Irish entrenchment, which they utilized; but it certainly is not the place where any landing of troops could be effected, as the entire coast is here rocky and precipitous.*

No. 59. Foliated head of a cross carved in relief on a tomb slab in Fethard church, county of Wexford.

No. 60. View of Ferrycarrick Castle, county of Wexford.

No. 61. Plan of the basement floor of the same.

No. 62. View of Ballymoon Castle, county of Carlow, looking N. W.

No. 63. Interior view of the same, looking S. E. This castle was erected in the year 1300 by the Knights Templars, just four years before the suppression of the order by Edward I. In plan it is a simple parallelogram, with walls of six or seven feet in thickness, sufficient to receive fireplaces, and recessed loopholes. A massive square tower of two arched rooms projects from the south wall, which is so far prolonged beyond the face of the east wall as to form a small flanking turret. The centre of the east wall is further protected by a small projecting angular tower. The archères, or loops, for either long or cross bow are remarkably characteristic of the Edwardian architecture, as are also the flat-pointed arch and flat-compressed arch of the various internal recesses. The wall was probably never much over fifteen or eighteen feet in height; but the tower, or keep, may have reached to thirty feet, or more.

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* The small expedition, consisting of five Welsh vessels, headed by Robert Fitz Stephen, landed, according to Giraldus Cambrensis, at Bannow Island in A. D. 1169, prior to the arrival of De Clare with the main army.

In the "Dictionary of Military Architecture of the Middle Ages in France," by M. Violet le Duc, he shows that massive wooden structures entered largely into the construction of the castles of the thirteenth, fourteenth, and fifteenth centuries, not only in the interior of such walls as those forming Ballymoon Castle, but along their summits. Without doubt, this effective mode of defence was adopted here after the most approved fashion; for the low walls of Ballymoon could offer but feeble obstruction to any determined escalade. The wall defences, therefore, probably consisted of a wide projecting covered gallery, resting on massive beams placed transverse to the wall, and called hoarding, thus making every portion of the wall impregnable to all modes of attack except that of fire, which the garrison, no doubt, knew how to resist.*

That our mediæval castles were thus protected by external wood work, forming galleries round the summit of the walls, is clearly proved at Trim Castle, where, two years since, I detected the ends of massive oak beams, broken short off, and filling large external putlock holes which surround the summit of the keep in two regular rows, far apart, the lower being for the struts, and the upper for the flooring of the galleries.

Thus we can understand the peculiar form of many castles, turrets, and walls, illustrated by Froissart, in his Chronicles, which before were not easy of comprehension, supposing the structures to have been entirely of stone.

No. 64. Effigy of a bishop, or mitred abbot, preserved in the wall of the courtyard of Slane Castle, county of Meath. From the rudeness of the sculpturing, and the absence of all details in the dress, with the exception of the large finger ring on the right hand, which is raised in giving the benediction, I should regard this as late fourteenth century, or possibly fifteenth century work.

No. 65. Plan of Clonmines Abbey, county of Wexford. From this it appears that originally the arch of the central tower was lighted on the south side by a beautiful window of three opes; subsequently this was built up, and a winding stairs constructed within it, which led to the summit of the tower. It is not easy to determine whether this change in the original plan of the building was made to strengthen the tower, or to add to it as a means of defence—possibly both. †

No. 66. Exterior view of the three-ope window once lighting the base of the central tower of Clonmines Abbey on the north, but subsequently built up, showing also the small loops for lighting the winding stairs within.

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* See Vol. III. of this series, for examples of loops from this castle.

† See Archdall's "Monasticon" for notice of this Abbey; and paper by the writer on the fortified church at Clonmines, published in the "Kilkenny Archæological Journal," vol. v., p. 27.

No. 67. Font from the old churchyard of Ballynaneen, county of Waterford.

No. 68. Bracket at the springing of the choir arch of the old church of Kildorrery, county of Cork.

Nos. 69, 70. Full-sized sketches of the capitals of the pillasters of probably the east window of Kildorrery old church, county of Cork.

No. 71. Moulding of aumbrey, or piscina, from the old church of Kildorrery, drawn to full size.

No. 72. Exterior of the doorway in the west gable of the old church of Kill St. Lawrence, county of Waterford.

No. 73. Exterior view of the east window of the old church of Kill St. Lawrence, restored; the external angles of the doorway and window being so broadly chamfered, show the building to be late thirteenth century, or early fourteenth century work.

No. 74. View of the ancient castellated and turreted wall, called Dun Mac Patrick, which spans the narrowest portion of the Old Head of Kinsale, from cliff to cliff, near the lighthouses.

No. 75. Principal tower of the wall of Dun Mac Patrick, viewed from the deep fosses, and looking westwards.

No. 76. View of one of the circular towers of the old fortifications of the city of Waterford, near the terminus of the Tramore Railway. The embattled merlons on various parts of the parapet between the embrasures are remarkably lofty and massive.

No. 77. Two crossbow loops from the tower just alluded to.

No. 78. Interior view of Preston's Gate, Athy, part of the old fortifications of the town. This is evidently early fourteenth century work, and shows the groove for the portcullis.

No. 79. Interior view of the Fair Gate of New Ross, with part of the flanking towers, showing the opening in the crown of the arch between the outer and inner archways to protect the portcullis. In the year 1862, when I last visited New Ross, every stone of the gateway was gone; and it is therefore possible that of this ancient gateway there exists but this sketch to show what it was in later years.

No. 80. View of Dean's Castle, near Carrick in Bannow, county of Wexford. This graceful rectangular tower, of unusual height, was originally much more lofty than it appears at present, as is evident from the brackets to support the bartizan, or eschanguette, to protect the doorway, being yet preserved at what is now the summit level of the walls.

No. 81. Plan of the basement floor and second story of this castle.

No. 82. View of main doorway and west window of Kilcrea Abbey, county of Cork. According to Ware, this abbey was founded by Cormack, surnamed Laida, Lord Muskerry, for the Franciscans, in A. D. 1465.

No. 83. One of the pillars of the side aisle arches from Kilcrea Abbey. The bases and caps of the pillars and the chamfers of the arches all correspond, and are remarkable for their simplicity, though at the

same time they are quite characteristic of the architecture of this period in Ireland.

No. 84. Flat joggled arch to a fireplace, from one of the buildings attached to Kilcrea Abbey. This arch is formed of five blocks of limestone, on either side of a central or keystone of a rude T-shape. Some of the flat arches for fireplaces of the fifteenth century are of most ingenious construction, and of these the one now illustrated is a good example.

No. 85. Large square castle, in the glen, and close to the south of Millstreet, county of Cork.

No. 86. View of Ballinacarriga Castle, county of Cork, erected by Mac Carty, sirnamed Carriga, or "of the rock," in A. D. 1585.

No. 87. View of the principal room in Ballinacarriga Castle.

No. 88. View of Carrickaphooka Castle, near Macroom, county of Cork.

No. 89. View of Dunsaughly Castle, county of Dublin.

No. 90. Tablet over the doorway of Dunsaughly Castle, bearing the following emblems of the Passion, *gravé en creux:*—The cross, with crown of thorns; the cloth, with the impression of the sacred heart, the hand and the feet; the ladder, spear, hammer, three nails, dice box, whipping post, with the rope and the three scourges. Below this are the letters IP - MD - G S - , probably the initials for John Plunket, Margaret Dillon, Genites Suæ, followed by the date, 1573.

No. 91. View of the doorway tower of Coolhull Castle, near Carrick, in Bannow, county of Wexford.

No. 92. View of Carrickadroghid Castle and bridge, near Macroom, county of Cork, view looking up the river.

No. 93. Another view of the same castle, looking down the river.*

No. 94. A nearer view of the same, also looking down the river.

The original sketches from which these have been taken were made before the partial destruction of the bridge by the great flood which carried away St. Patrick's Bridge at Cork, and the bridge below Macroom, some years back.

No. 95. View of the old Bawn of Tully, called Tully Castle, on Lough Erne, near Kesh, in the county of Fermanagh.

No. 96. Plan of the same fortified house and outworks.

From the occurrence of large circular brackets, such as would support small turrets, at the north-east and north-west angle of the wall of the principal building, and which are about fifteen feet from the ground, it is probable that the northern side of the second floor was entirely constructed of wood, in the form of a gallery, to defend this side of the castle.

No. 97. Carved stone, probably the lintel of a fireplace from the old castle of Macetown, county of Meath. At the left-hand end of the stone is a shield, bearing the arms of Cheever—three goats passant, surrounded by a wreath; at the opposite end is a shield, with the arms of Plunket—a castle, with the bend sinister, or erased. The central portion of the stone bears the motto "EN . DIEV . MA . FIAVNC ." (*fiance*) that of the Cheever family; below which is the inscription*

CHRISTOFOR . CHEVER . RMIG ET . DAME ANE . PLUNKKET.

No. 98. Monumental slab of the family of Nugent, Barons of Delvin, from the east wall of the ruined church of St. Mary's, at Fore, in the county of Westmeath. The inscription, which is intended to be a clear and succinct account of the pedigree of some families of this branch of the Nugents, is so completely the reverse, that I transcribe it as a genealogical curiosity:—

THES . MONUMENT . WAS . FIRST .
BEGUN . FOR . OLIVER . NUGENT .
OF . BELENA . IN . THE . COUNTY
OF . MEATH . ESQ . BROTHER . TO
THE . HONORABLE . RICHARD .
LORD . BARON . OF . DELVIN . BY .
CHRISTOPHER . NUGENT . HIS
SON . AND . HEIR . WHICH , OLIVER
DIED . THE 17 OF . MARCH 1589 . AND
WAS . HERE . ERECTED . AT . THE . COST
AND . CARE . OF . ROBERT . NUGENT . OF
CLONEGIRACH . AND . XPHER . N$^{T.}$
GRANDCHILDREN . TO . THE . S$^{D.}$,
XPHER . OF . NICHOLAS . & ROBERT
SON . OF . OLIVER . N$^{T.}$. OF . WILLIAM
XPHER . EDMOND . & RICHARD
SONS . OF JAMES . N$^{T.}$, BOTH . NEPH
EUS . TO . THE . S$^{D.}$. AND . OF . EDMOND
N$^{T.}$. GRANDCHILD . TO . THE . S$^{D.}$ XPHER
& THOMAS . HIS . SON . FOR . THE
INTERRING . OF . THEM . & THER
POSTERITY . ANNO . DOM. 1689
GOOD . XPIANS . PRAY . FOR
THESE . HERE . INTERRD.

The inscription is surmounted by the Nugent arms, with the motto "DECREVI."

No. 99. Coat of arms and inscription over the doorway of the old Castle of St. Johnstown, county of Tipperary. The shield is of the sixteenth century type, and bears quarterly, 1st and 4th, three fish proper; 2nd and 3rd, ermine, or, six scollop shells, three and three. The inscription is as follows:—

ROBERT DE SETŌ . IOH̄E . DN̄S DE -
SCADANSTOWNE . LISMAINAN . CVOLAGH
ET TOCIVS PLEBIS ILLIVS . ME FECIT.

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* Evelyn P. Shirley, in his "Memoir on the Arms of the Landed Gentry of England," gives three goats passant as the arms of Thorold of Marston, Bart., 1612. This coincidence is somewhat singular, and is not unworthy of some explanation.

The three fish are the bearings of the Hacket family, one of whom founded the Franciscan Monastery at Cashel in the early part of the fourteenth century, and who held a high social position in the counties of Tipperary and Cork for many centuries.*

No. 100. Sketch of a monumental slab placed over the doorway of the old chapel of Tubbrid, near Clogheen, in the county of Tipperary, which, though simple and of no great antiquity, may yet be regarded with feelings of veneration as sincere as were ever bestowed on the tomb of one of our most illustrious kings. This is the memorial slab erected to the memory of Dr. Galf. Keating, the author of the well-known "History of Ireland," and justly termed "The Irish Livy." It commences with the initials I. H. S., surmounted by a cross, followed by a monagram for Ave Maria, and thus continues:—

ORAte *Pro Aiabꝰ*
P. Eu*genu* : *Duby*
Vic de Tybrud : *et*
D : *Doct Galf* : *Kea*
ting huiꝰ Sacelli
Fundatorū : *necnō*
et pro ōibꝰ alustū
sacerd . quam laicis
quorū corpa in eod : *jacet*
sa A° Dom̄ 1644.

In the foregoing Catalogue to accompany the seventh Volume of my Antiquarian Sketches, which I have had the honour to present to the Library of the Academy, I have not attempted to investigate the historical facts relating to the various objects I have sketched, from want of time for such a purpose. These Sketches are the product of my leisure hours, and their defects, which are very apparent, will I trust be overlooked when the object which I have in view is understood—that of endeavouring, as far as my unaided efforts will allow me, to record in truthful outline many an object of antiquarian interest, which in my own memory has ceased to be, or which will disappear in a few more years.

In conclusion, I wish in justice to myself to reply to some unjust criticisms openly passed on this collection of Drawings when they were exhibited and presented to the Library of the Royal Irish Academy on the 9th of April last, and when I was not present to answer or explain. I state distinctly that all my drawings of antiquities in this and the

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* See sketch of the tombstone of the Hackets from Morne Abbey, south of Mallow, county of Cork, Vol. III. of this series.

other six volumes are taken from original sketches made by myself, with but very few exceptions, and then I name my authorities; and if I sometimes illustrate anew what has already been published, I know that I thereby correct an error, and do good service to the cause of antiquarian truth.
G. V. D.

Resolved,—That the warm thanks of the Academy are due, and are hereby returned to Mr. Du Noyer for his very generous and valuable presentation.

The President under his hand and seal nominated and appointed the following Members of Council as Vice-Presidents of the Royal Irish Academy:—

The Very Rev. Charles Graves, D. D.;
The Rev. George Salmon, D. D.;
W. K. Sullivan, Esq., Ph. D.;
Sir William R. W. Wilde, M. D.

MONDAY, APRIL 23, 1866.

William K. Sullivan, Ph. D., Vice-President, in the Chair.

Mr. Alexander Macalister, Demonstrator of Anatomy, Royal College of Surgeons, Ireland, read the following paper:—

Notes on Muscular Anomalies in Human Anatomy.

The rapid advances which have been made of late years in the knowledge of comparative and embryological anatomy and their kindred sciences have given a stimulus to our researches after muscular irregularities in the human subject, as in these we frequently find the clue to the explanation of the varying positions and modes of arrangement of normal muscles, both in man and other animals. Although Huxley and Wood in this country, and Henle, Theile, Kelch, Hyrtl, and Meckel on the Continent, have written much on this subject, yet such is the variability of the human frame, and of so frequent occurrence are novel irregularities, that it often falls to the lot of other observers to examine specimens which have not as yet been placed on record. For the past eight years, during which time I have been connected with the anatomical room of the Royal College of Surgeons, I have preserved notes of all the more important deviations from the normal types which I have observed, and of these there are some which, to my knowledge, have not been as yet made public.

As it seems to be a law of nature that the complex types of organization are much more liable to irregularity than the simpler forms, so we should expect to find the human structures more disposed to abnormal modes of arrangement than the parts of other Vertebrates; and such, indeed, seems to be the case. Whether these irregularities are connected with corresponding varieties of vital individuality, it is usually impossible to determine, and concerning the causes which bear on their production we know little. I have found them more commonly on the right side than on the left, and in females more frequently than in males. The influence of sex in determining the occurrence of anomalies is probably, however, very slight; for though in my notes I find that a considerable preponderance of the cases occurred in females (as a greater number of individuals of this sex are submitted to our observation in the dissecting room), yet others have remarked the contrary; and it is probable that, had we a sufficient body of evidence, we would find the numbers tolerably equal in both sexes. I can in general concur fully with the introductory remarks of Mr. Wood, in his admirable papers on this subject, in the "Proceedings of the Royal Society" for 1865.

The varieties which I am about to notice may be arranged into six classes:—

1st. Such as arise from the presence of muscles not typical parts of the human frame;
2nd. Variations of normal muscles by duplicity, either in whole or in part;
3rd. Variations of normal muscles by complexity or alterations of attachment, of course, or of arrangement;
4th. Variations by the coalescence or union of muscles normally separate;
5th. Variations by segmentation, or the fission of muscles into several parts;
6th. Variation by suppression, either partial or complete.

This arrangement, it will be seen, is an extended modification of that adopted by Mr. Wood, and for practical purposes will be found extremely convenient.

I. The first, and most interesting group of anomalies comprises all those muscles which are occasionally present, as if by accident, in man, although not normal constituents of the human frame, either in rudiment or in perfection. Most, if not all, of these are natural elements existing in lower animals; and when they occur in man, they are usually unconnected with his normal muscles. In some of the instances in which I have noted them, they were gregarious in their occurrence, two or more anomalies of this class being present in the same individual, and in the majority of instances they were symmetrical.

The following are the principal varieties of this class which I have observed:—

1. Sternalis rectus I have seen many times, varying in its degree of development, from a few vertical fibres or tendinous bands running in front of the sternum, either from the sternal tendon of the sterno-mastoid, or from the manubrium, to its full perfection, as a large fleshy mass, separate from both rectus abdominis and sterno-cleido-mastoid.

In one instance it was double; but in all other cases it was single, and on the right side. Its usual attachments, in six or seven instances, I have found to be from the inferior border of the manubrium sterni to the upper margin of the fourth, fifth, and sixth costal cartilages, and in none of the cases where it was large and fleshy was it connected with the sterno-mastoid. Its length varied from three to six inches, and its breadth from half an inch to two inches. In one instance its tendon of origin was an inch and three-quarters in length; but I have never detected tendinous intersections in its belly, as described by Meckel; it always overlay the great pectoral, and often coexisted with other anomalies. The nature of this muscle as a thoracic representative of the rectus has been clearly shown by Theile and Meckel.

2. Cephalo-pharyngeus externus of Theile, or at least a somewhat corresponding muscle (Plate VI., fig. 1, *b*) I found in one instance arising from the inner and posterior extremity of the vaginal process of the temporal bone, and from the rough inner angle of the petrous portion, external to the first attachment of the superior constrictor of the pharynx. It ran downwards and inwards, parallel, but internal, to the stylo-pharyngeus, and was inserted into the mucous membrane of the pharynx, passing between the middle and superior constrictors. This might be a modification of the true salpingo-pharyngeus muscle of Haller and Cruveilhier, but in my case it had no connexion with the Eustachian tube.

3. Another small pharyngeal muscle, similar to that named by Meckel the azygos pharyngei, I have found on several occasions (Plate VI., fig. 1, *a*), arising from the central spine, on the basilar process of the occipital bone; and, being inserted into the raphe of the pharynx, superficial to the insertion of the superior and middle constrictors; with the ascending fibres of the latter muscle it is often confounded. It is present in the pharynx of several Mammals, and is commoner in them than some imagine.

4. An additional scalenus muscle has been described by Albinus and Meckel as an occasional development in the neck. The former author has named it scalenus minimus, and in some instances this organ has been found cleft into two distinct parts, internal and external. It arises from the first rib, and is attached to the anterior tubercles of the transverse processes of the fifth, sixth, and seventh cervical vertebræ; it usually passes between the subclavian vessels and the lower cervical nerves. In one instance in which I found this muscle to exist, it was further complicated by the total suppression of the scalenus anticus; but they not unfrequently coexist, and in seven subjects selected at random in the dissecting room this muscle existed symmetrically in three.

5. I have likewise been able to demonstrate most distinctly in one case the presence of a fifth scalene muscle (Plate VI., fig. 2, *b*), situated under cover of the scalenus medius. This structure was much stronger than the normal scalenus anticus, and was inserted above into the posterior tubercles of the transverse processes of the fourth, fifth, and sixth cervical vertebræ, and arose from the first rib below, at the anterior bor-

der of its tubercle, within and behind the insertion of scalenus medius, from which, part of the upper roots of the brachial plexus and a plane of cellular tissue separated it. The insertion of the scalenus medius in this instance was extended farther upwards than usual, and was connected with the posterior tubercles of the transverse processes of the first, second, and third cervical vertebræ. The scalenus posticus was normal.

To the above described muscle perhaps the name scalenus accessorius might be given. I have found it present in some of the Quadrumana.

6. An unimportant, though distinct muscle, for which I would suggest the name rhombo-axoid (Plate V., fig. 1, *a*), I found in one subject, arising from the spinous process of the seventh cervical vertebra, underneath the rhomboideus minor, and closely connected to its origin. Its fibres ran upwards, forwards, and outwards, in a round fasciculus, and, becoming tendinous, were inserted into the transverse process of the atlas. This band lay first on the serratus posticus superior, and then on the splenius colli.

7. I have very frequently found in man a small muscular slip (subscapulo-capsular, *mihi*), to which the name infraspinatus secundus has been given by Professor Haughton (Plate VII., fig. 2, *a*). When present, it arises from the anterior aspect of the axillary border of the scapula, immediately below its neck, usually overlapped by the subscapular muscle, and anterior to the origin of the long head of the triceps; from this it passes outwards, and is inserted into the inferior and anterior part of the capsular ligament of the shoulder joint. I have found this muscle either quite separate from the subscapularis, or else conjoined with its lower border. Among the Mammalia I have seen it in the horse, seal, and many others; and Professor Haughton has kindly informed me that he has found it present in several of the larger Quadrumana, in some of which it was particularly well developed, especially in *Macacus nemestrinus*. In the majority of cases among animals this muscle has little or no connexion with the capsular ligament, but it is usually inserted into a point intermediate between the posterior surface of the lesser tuberosity and the inner lip of the bicipital groove. The human muscle would thus seem to have a special action to make tense the capsular ligament, and to prevent its being pinched in rapid motions of the joint; it is probably the upper extremity representative of the glutæus quartus of Mayer and Haughton.

8. Coraco-capsular is a small muscle described by Mr. Wood, which I have rarely found present: in the few instances in which it has occurred, it arose under cover of the coraco-brachialis from the under side of the extremity of the process, and was inserted into the upper and anterior part of the capsule. It sometimes seemed as it were an offshoot from the coraco-brachialis, but more commonly when present it is distinct. I have found it existing and very distinct in Cebus and Callithrix; and in these it usually passes completely over the capsular ligament, to be attached to the front of the neck of the humerus. From its origin and from the relation of its insertion to the capsule and to the lesser tuberosity, it might perhaps be considered as the humeral homotype of the qua-

dratus femoris. This and the foregoing are functionally analogical, as they are both tensors of the capsular ligament. Gantzer has described a third muscle, with a similar action, passing from the cartilage of the first rib to the same destination under cover of the lesser pectoral.

9. Extensor primi internodii pollicis et indicis of Wood I found in one subject, in 1858, arising from the ulna below the extensor secundi internodii pollicis, and above the extensor indicis, the tendon of which latter muscle united with the indicial slip of the anomalous extensor, and was inserted into the second and third phalanges of the index finger. This muscle exists in the dog and fox.

10. An extensor annularis proprius, which may be regarded as a rudiment of an extensor digitorum brevis manus, I found in the left hand of a female subject, arising from the dorsal aspect of the cuneiform bone and annular ligament and heads of the fourth and fifth metacarpal bones. The muscle extended forwards, and ended in a single tendon, which was inserted into the inner side of the long extensor tendon of the ring finger, about the base of its first phalanx. Another rudiment of the short extensor of the fingers I found in a male hand, similar to the foregoing, but passing to the middle finger only, and quite separate from the interossei. Not unfrequently I have seen the dorsal interossei sending off slips, which seemed as though representatives of the same extensor muscle.

11. In this class of irregularities I would place several instances of double interossei in the hand, which I have at different times observed, both involving the palmar and dorsal groups of muscles. The former I have found doubled in four different subjects—the latter in one instance. In this case there were two muscles lying in each inter-metacarpal space, each inserted by a tendon into the corresponding side of the finger. (This instance is reported in "The Medical Press," vol. ii., p. 413.) The former cases likewise showed twin muscles lying on the palmar aspect of each interspace, except that between the first and second metacarpal bone, each inserted into the outside and inside of each finger, respectively: in these cases the dorsal interossei were normal. There are several anomalies of these muscles on record, but none of them in anywise resemble the foregoing, which I would venture to suggest might throw light on some points of the homologies of these muscles. It has often been a matter of comment that there is a strange want of symmetry in the arrangement of these muscles in the hand, as well as a want of conformity in the attachments of the homotypical muscles in the hand and foot. This is accounted for by Mr. Wood, because, as the middle finger in the hand is the most bulky, it is assumed as the centre of motion; and it has two dorsal interossei to produce its divarications, and its divaricator to the pollex excludes from the third metacarpal bone the divaricator from the pollex of the second digit, and obtains an origin for itself from the dorsal aspect of the second metacarpal: so, instead of being a palmar, it becomes a dorsal interosseous muscle; and this is supported by the fact that the transverse convexity of the dorsum of the hand gives to the metacarpal bone of the middle digit a prominence

over the others. Though the explanation may be quite satisfactory, yet it has struck me that perhaps another interpretation might be given in the light of the present varieties. It might be that for each finger as a separate individual member four muscles might be provided in a typical hand, two dorsal interossei, and two palmar, the former as extensors and lateralizers, the latter as flexors and lateralizers; but the fingers being grouped as in the human hand, and the extensor and flexor action being for the most part monopolized by the long special muscles for the purpose, the secondary or lateralizing function becomes paramount; and, as two muscles for each action would usually be unnecessary, a suppression takes place of the superfluous dorsal and the palmar interossei. Then perhaps the dorsal prominence of the third metacarpal is the cause that the muscles which in the human hand become obsolete on the dorsum are the adductors, but on the palmar aspect the opposite set disappear. We still retain a trace of the double nature of the dorsal interossei in their bicipital origins, as I think the deduction arrived at by Meckel may be with reason accepted, that the bicipital attachment of a muscle is usually a sign of the lateral coalescence of separate parts. If this explanation be true, these varieties would show the typical or unaltered state of development, respectively, of each set of muscles.

12. Glutæus quartus of Mayer and Haughton, (ilio-capsular of Harrison). This muscle is not by any means a rare constituent of the human body; its existence I have noticed in many animals; and Professor Haughton has furnished me with numerous instances in which he has found it to be a distinctly existing element, as in the lion, kangaroo, rhea, &c. In man it usually runs from the anterior inferior spine of the ilium, and is inserted into the capsular ligament of the hip joint, and sometimes into the anterior intertrochanteric line above the lesser trochanter. It may be of use as a special tensor of the capsule, or as a rotator outwards or abductor of the hip joint, and seems to correspond with the infraspinatus secundus in the shoulder; it varies in degree of development, and is present as frequently as the psoas parvus.

13. The peronæus quartus I have seen as a distinct muscle, arising from about two inches of the front of the fibula, at the junction of the upper three-fifths with the lower two-fifths of the bone, above the peronæus tertius, from which, as well as from the extensor digitorum longus, in one case it was completely distinct, and in other instances it was with facility separated. Passing under the annular ligament along with the extensor digitorum longus, it was inserted tendinous into the base of the fourth metatarsal bone. In one subject in which this muscle existed, the peronæus tertius was absent; in another instance the two tendons arose from the same muscle; and I have seen this tendon detached from the outer slip of the long extensor of the toes. In one strong muscular subject the tendon of the peronæus quartus was as strong as the flexor carpi radialis tendon at the wrist. A slip somewhat homotypical I found in the right forearm of a dingo, running from the dorsum of the ulna to the fourth metacarpal bone.

14. The slip called peronæus quinque, or the band extended to the

extensor aponeurosis of the little toe, I have seen on several occasions, but I never have found it existing as the tendon of a separate muscle; it always was an offshoot, commonly from the peronæus tertius, or in three cases from the peronæus brevis, and as such I have found it present in Cercopithecus. (Since the writing of this paper I have seen it as a perfectly distinct muscle, arising under cover of peronæus brevis.)

15. I can fully confirm Mr. Wood's statement as to the frequency of the existence of the abductor ossis metatarsi minimi digiti of Huxley, Flower, and Wood. The latter author was the first to direct attention to it as a human muscle; but even before the publication of his paper, I have been long in the habit of demonstrating its existence as a slip, separate from the abductor minimi digiti; indeed I have found it present in nine out of every twelve subjects.

16. A description of a sixth peronæal muscle has been communicated to me by Mr. Macmullen, who found a distinct fleshy belly, taking origin from the lower third of the outer surface of the fibula, over the peronæus longus, and winding round the back of the outer malleolus, to be inserted into the posterior and external surface of the cuboid bone. In this subject the peronæus tertius was absent, but the longus and brevis were present and normal.

17. Tibio-fascialis anticus was a muscle found in one subject arising from the lower third of the anterior edge of the tibia, over the tibialis anticus, and passing downwards to be inserted into the annular ligament, over the extensor digitorum communis tendon, as well as into the lower border of the deep tibial fascia.

18. The levator claviculæ of Wood I have only once seen, in the neck of a spare female subject, and under cover of the clavicular fibres of the trapezius, inserted into the posterior border of the outer third of the clavicle.

19. The levator glandulæ thyroidei of Sömmering I have found either as a separate muscle, or as an offshoot from the inner edge of the sterno-thyroid or the thyro-hyoid muscles.

20. Fibres of a hyo-epiglotticus muscle I have once traced distinctly, under cover of the glosso-epiglottic ligament, from the posterior surface of the body of the hyoid bone to the anterior surface of the epiglottis, overlying the so-called epiglottic gland.

21. Crico-thyroideus posticus (somewhat similar to the kerato-cricoid of Merkel) was a small band of muscle, which arose from the side of the cricoid cartilage, directly below, and extending a little anterior to the articulation between the inferior cornu of the thyroid cartilage and the side of the cricoid. From this origin its fibres ran upwards and forwards, to be inserted into the lower border of the thyroid cartilage (Plate VI., fig. 3, *a*). It was situated below and behind the normal crico-thyroid muscle, from which it was quite separate, and differed in the direction of its fibres. Its cricoid attachment was external to the outer border of the crico-arytenoideus posticus, with which some of its fibres were slightly connected. The larynx in which this muscle

occurred was peculiar, as in it the thyroid cartilage had no superior cornua.

22. A small muscular mento-hyoidean band (Plate V., fig. 2, *a*), existed single in one subject, but double in another, arising from the inferior surface of the mental ridge on the lower jaw, and running backwards to be inserted into the middle of the body of the os hyoides. For the sketch of this muscle I am indebted to Mr. Macmullen. In all instances it was perfectly separate from the digastric.

23. I have several times found present on the side of the thorax a small or well-developed supra-costalis muscle. Once this occurred in an old though tolerably muscular female. Another instance was in a male subject of enormous proportions; it arose from the lower border of the third or fourth rib, about six inches and a-half from the outer edge of the sternum. On the right side I have generally found it narrower and thicker than on the left; it measured in one instance three inches and three-fourths long, three-quarters of an inch in breadth, and one-eighth of an inch in thickness; but I have seen it much larger. From its place of origin it extended vertically upwards, lying on the upper digitations of the serratus magnus, and shortly in front of the respiratory nerve of Bell; then, ascending behind the axillary vein and subclavius muscle, it was inserted into the first rib on the right side, in one instance over the origin of the first slip of the serratus magnus. On the left side in this subject, however, and in several cases on the right, it cleared the bone, and, expanding, was inserted into the deep cervical fascia in the posterior inferior triangle of the neck. It lay considerably external to the origin of the lesser pectoral, which covered it, with the intervention of a strong aponeurotic expansion, derived from the deep axillary fascia, and its insertion was placed internal to the scalenus anticus. Mr. Wood has described a somewhat corresponding muscle, which, however, differs from the foregoing in being placed anterior and internal to the serratus magnus; and, secondly, in having no upper fascial connexion, but being purely costal in its attachments. His slip extended to the fourth rib, and he has described its course as from above downwards; but as in the most of the instances which I have seen, it evidently acted on the cervical fascia, I have taken the liberty of inverting the order of description. The muscle occurs in several monkeys, in the seal, and in *Balænoptera rostrata.* It seems to have no connexion with or relational analogy to the rectus sternalis.

24. I have met with a distinct extensor ossis metatarsi hallucis, and have also seen this muscle existing as an offshoot from the anterior edge of the tibialis anticus; in the latter subject there existed (25) an extensor primi internodii hallucis, which lay between the former muscle and the extensor hallucis proprius; this latter slip was perfectly unconnected with all the surrounding muscles. In an egret monkey I have seen the extensor ossis metatarsi hallucis without any trace of another extensor for the hallux, while in others of the Quadrumana both the extensor ossis metatarsi and the extensor secundi internodii exist.

II. The second class of muscular varieties comprises those instances in which we find normal muscles multiplied by simple reduplication, the double portions either being placed in different planes, or in different vertical positions. The former arrangement I have found to be rather the more frequent, and it has occurred, in my experience, to several muscles. We must, however, be careful to distinguish abnormalities of this class from those of the fifth group, with which they are liable to be confounded; the main distinction being that, whereas in every example of this class all or some of the portions of the varying muscles are doubled, in the fifth subdivision, on the other hand, each part is but single, although severed from those others with which it normally should be united.

1. The rhomboideus major I found to be the seat of a partial variety of this class, on the left side of a female subject. It was almost completely split into two planes of fibres, especially along its lower border. At the upper edge of the muscle the fibres of the different planes coalesced more or less distinctly.

2. The pectoralis major has been on several occasions partially cleft into two planes, more or less distinctly, and in one case was perfectly severed. This arrangement occurs in the horse, sheep, and dog.

3. The sterno-thyroid was double on the left side of a strong male subject, the two portions lying parallel; and (4) on the same side of this subject there was a double levator anguli scapulæ.

5. In the right forearm of a thin female subject the supinator longus was double for the largest part of its extent, while the same variety was presented in a corresponding extremity in the case of the (5) palmaris longus. The double arrangement of the former muscle occurs, according to Meckel, in the three-toed sloth, and in the anteater; it is likewise cleft in the seal.

7. The abductor pollicis brevis manus I found presenting this anomaly—the two muscles lying parallel, and separated by a cellular interval. This state was described by Sömmering, who believes it to be the normal arrangement of the muscle.

8. The rectus capitis lateralis, and (9) rectus capitis posticus major and minor, were each in at least one instance found double.

10. The extensor ossis metacarpi pollicis I have seen in several instances presenting this irregularity: in one case three parallel muscles and tendons existed; in another the muscle at first was single, but ended below in two bellies, which were inserted by tendons quite separate and distinct from each other, the inner of which overlapped the outer (11). The same varieties I have seen to occur in the case of the extensor secundi internodii pollicis.

12. The extensor minimi digiti I have likewise seen entirely doubled. Usually, however, when this condition occurs, the tendons and bellies of the two muscles separated except for about an inch or so from the origin, and by no means unfrequently a single belly existed, from which two tendons were detached, both of which were distributed to the little

finger. I have likewise seen three tendons arising from a common muscle, one of which passed to the fourth finger, and was continuous with the extensor tendon of that digit opposite the end of the first phalanx; the other pair of tendons were, as usual, distributed to the little finger. This arrangement I have likewise found in a species of Cebus.

13. The solæus was in one subject doubled; the accessory or second portion lying under cover of the normal muscle, and connected to the deep-seated surface of the tendo Achillis.

14. Two perfectly distinct planes of fibres I have been able to detect in the glutæus maximus on several occasions, especially along the inferior border of the muscle: these were separated by a cellular lamina.

III. Under the third head I place all those irregularities which arise from the presence of additional origins, supernumerary tendons, unusual insertions or relational deviations from the ordinary arrangement of parts; and these, as might be supposed, constitute the most numerous group of muscular anomalies. They may be the results of original abnormal development, or the products of disease or injury. The latter forms I have, however, excluded as far as possible from my list, as they cannot possess much value in comparative anatomy. I have found illustrations of this class involving the following muscles:—

1. Latissimus dorsi. In many cases I have found this muscle to be errant either in its origins or insertion. The former have been extended as far upward as the fourth dorsal spine, or have not reached beyond the first lumbar vertebra, or have been attached to the inferior angle of the scapula; and the latter I have seen sometimes sending a considerable accessory slip from its lower border into the fascia of the arm. This band attains a considerable degree of development in Cebus, and other monkeys. A portion of this tendon is often continued into the long head of the triceps, and this I have found to occur about three times in every thirty subjects. I have also seen the long tendon of the triceps taking an origin more or less extensively either from the lower border of the latissimus tendon alone, as in Cebus, or from it and teres major combined.

Very much more rarely a fascial expansion, or even a musculo-tendinous slip, has passed from the lower border of the latissimus dorsi down as far as the olecranon process; this we find to exist in the gibbon, in Ateles, Cynocephalus, and many others of the Quadrumana. A similar portion exists in the horse; and a muscle somewhat corresponding I have traced in the pig, running from the inferior angle of the scapula to the fascia on the inner side of the limb, over the triceps. In many of the instances among the Quadrumana, where this muscle exists as a supplement to the triceps, it is quite separate from that muscle, even to its insertion; and it is not improbable that it may be the fore-limb homotype of the sartorius muscle, as in both cases the muscles are superficial to the rest of the extensor mass, in both instances placed on the extensor aspect of the limb, and both usually run from without inwards. In confirmation of this there are instances recorded both in man and other animals where the sartorius femoris ended either by being inserted into the extensor muscles, the fascia of the thigh, or the patella.

Another slip of the latissimus I have found crossing the bicipital groove, and binding the long head of the biceps in its place, to be inserted into the anterior edge of the groove, under cover of the tendon of the pectoralis major: the same arrangement I have found in Cercopithecus. A slip of fibrous tissue also exists not unfrequently, passing from the upper border of the tendon of the latissimus to the lower and inner border of the capsular ligament of the shoulder joint, stretching along the inner lip of the bicipital groove, and corresponding to the suspensory frænum of Winslow from the great pectoral tendon along the outer lip.

2. The lower costal fibres of the great pectoral muscle, in a stout female subject, detached a distinct chondro-epitrochlear slip, which, arising from the seventh costal cartilage, passed outward, and ultimately downwards, to be inserted into the upper part of the inner condyle of the humerus by a round tendon. This variety is of interest, as usually the costal fibres of this muscle are inserted above and behind the sternal and clavicular portions. This muscular slip has been found taking different courses, and inserted either into the brachial aponeurosis, or intermuscular septum, when it is called the chondro-fascial, or even into the short head of the biceps, the latter attachment being similar to the mode of arrangement in *Hylobates leuciscus*, in which the entire short head of the biceps springs from the pectoral muscle: the former we find in the pig, where the lowest fibres of the pectoral extend down to the fascia over the inner side of the ulna. I have found this epitrochlear slip in one instance detached from the clavicular portion of the muscle.

I have also found the long head of the biceps splitting the tendon of the great pectoral, and passing down between the costal and sternal fibres which were behind it and the clavicular fibres which lay in front of it—a condition which has its prototype in Quadrumana.

3. The omo-hyoid sometimes took an origin from the posterior border of the middle third of the clavicle. In one of these cases its scapular origin was completely suppressed, and its clavicular attachment was overlapped by the extended fibres of the trapezius.

4. The upper fibres of the serratus magnus of a slender male subject extended at their insertion as far forward as the posterior border of the suprascapular notch, behind the omo-hyoid muscle, and so occupied the entire of the superior costa of the scapula. In this subject, likewise, the superior and middle parts of that muscle were separated by a considerable cellular interval, so as to appear quite distinct from each other. This variety occurred to Theile in a subject in which the omohyoids were absent.

5. The rectus abdominis I have found to vary much in the extent of its attachments: sometimes it ascended as far as the fourth

rib, lying superficial and internal to the great pectoral; on other occasions it passed outwards as far as the cartilage of the eighth rib. The former case seemed to be an attempt at a rectus sternalis.

6. The sartorius muscle I have seen extending at its origin along Poupart's ligament for a short distance from the anterior superior spine of the ilium, and by its deep-seated surface united to some of the superficial fibres of the iliacus internus.

7. My friend and former pupil, Dr. Raye, has furnished me with a note of an interesting variety, which he had found occurring in the case of the subclavius muscle. It is well known that not very uncommonly this muscle is continued outwards beyond the clavicle to the acromion process of the scapula; but in this instance, "on the left side the muscle was not inserted into the clavicle at all, but, passing free from that bone, was attached to the ligament of the notch, and to a small portion of the outer extremity of the superior costa of the scapula external to it. The omo-hyoid arose more internally from the superior costa, its usual position being occupied by the subclavius. The suprascapular artery separated these muscles. The subject was a female, and the same anomaly occured on the right side." Mr. Wood, in describing a similar irregularity, mentions that it coexisted with a normal subclavius; and consequently he regards it as a distinct muscle. In his subject, likewise, it was united at its insertion to the omo-hyoid; so in both these respects the instance recorded by him differs from the case given above. Mr. Wood regards it, and with sufficient reason, to be the representative of the Mammalian sterno-scapular muscle, which I have found in many Mammals taking a similar course. In a porcupine which I lately dissected this muscle closely resembled our anomaly, except that, crossing over close to the superior costa, it was inserted into the posterior two-thirds of the spine of the scapula. A similar arrangement I have found in a pig.

8. The occurrence of additional heads to the biceps flexor cubiti has long been familiar to anatomists, and is among the best known of muscular anomalies, having been described by Struthers, Meckel, Theile, Kelch, and others. I have not in my dissections verified Theile's experience that this variation occurs once in every eight or nine subjects, as out of forty subjects taken at random through the last session I noticed its presence only in two; and from my previous experience of its occurrence I would be inclined to state its frequency as being about once in twenty-five cases.

Among the different forms of this variety, the following are the principal:—(1). The most common consists of a slip from the brachialis anticus, interesting as the representative of the short head of the biceps flexor cruris; (2), sometimes a similar head may come from the supinator longus; (3), from the pronator teres; or, more, rarely (4), I have seen a band arising from the humerus, inseparable from the insertion of the coraco-brachial, and uniting with the biceps at the middle third of the arm; (5) the accessory origin may be, as described by Meckel, from the greater tuberosity of the humerus; (6), or, as described by Mr. Wood, from the lesser tubercle: of the former I have notes of two cases, of the latter three instances have occurred in my experience. In all cases but one which I have met with those anomalies have been symmetrical. (7). An accessory head may pass from the great pectoral to the short head, as in Hylobates; or (8), a similar slip may run from the lesser pectoral to the same place: these latter probably are about the rarest forms of supplemental origin.

9. A radial origin for the flexor carpi radialis in place of, or in conjunction with, the ordinary condyloid head, is another variety which I have noticed. The aberrant slip in these cases sprang from the bone, between the insertion of the pronator radii teres and the radial origin of the flexor sublimis digitorum. In one instance, however, in which the pronator teres was destitute of a coronoid head, a distinct tendinous slip passed downwards and forwards from the inner lip of the coronoid process of the ulna, and was inserted into the outer and deep surface of the radial flexor, being separated from the condyloid origin of the muscle by the median nerve and the brachial artery.

10. The palmaris longus is frequently the seat of variation. I have found it reversed; its tendon being connected to the inner condyle, and its lower end being fleshy for about two inches and a half, and inserted below into the annular ligament and palmar fascia; but this variety may rather be regarded as arising from the presence of a new muscle; the palmaris longus secundus taking the place of the obsolete palmaris longus, as I have seen several times the two muscles present in the one forearm—first the proper palmaris, and to its inner or ulnar side the accessory muscle, as above described (Plate VIII., fig. 1, *a*, *b*). I have found an intermediate variety of this muscle, in which the origin and insertion were tendinous, while the fleshy belly, two inches long, had a central position (Plate VIII., fig. 2, *c*). These varieties have, for the most part, been already recorded by Quain and Cloquet. The site of origin of this muscle, likewise, may vary: I have found it springing from the lowest point of the condyle, under cover of the flexor sublimis digitorum, or from the radius, in place of the radial origin of that muscle. Its insertion I have seen connected by oblique tendinous bands to the pisiform bone, external to the tendon of the flexor carpi ulnaris. In other subjects I have seen a slip of the flexor sublimis taking its place; and sometimes, but very seldom, its tendon was united below to that of the flexor carpi ulnaris, reminding us of its position in the two-toed anteater, where, according to Meckel, these two form but the one muscle. This latter condition I have seen in two subjects.

11. The flexor pollicis longus possesses frequently a condyloid and occasionally a coronoid origin, which is sometimes large enough to produce by its tendinous intersection, where it unites with the radial fibres, the appearance of a large digastric muscle, and this band in one subject was a little complex in its relations. It sprung from the process in the situation where usually the second head of the pronator teres

arises (which, however, was in this instance deficient), and shortly after it was joined by a slip from the flexor digitorum sublimis. The conjoined slip thus formed passed behind the ulnar artery, and terminated in the flexor pollicis longus.

12. The extensores carpi radialis longior and brevior are not unfrequently the subjects of altered attachments and course: most usually, however, their varieties belong to the class of anomalies by coalescence. I have in my notebook the records of a very singular interchange which occurred between the tendons of these muscles. In this subject the tendon of the extensor longior, a short distance below its origin, divided into two slips, one of which, becoming tendinous, passed off to unite with a similar offshoot from the extensor brevior. The conjoined tendon thus formed passed for a short course between the slips which represented the typical muscles, and then bifurcated, each of the resulting tendons being inserted under cover of the normal insertions of the type muscles, respectively, into the second and third metacarpal bones. This may be in some slight degree a representative of the mode of insertion in the ornithorhynchus, where a single tendon terminates in three slips for the three outer metacarpals; but the peculiar double mode of insertion is, to my knowledge, unexampled in the animal kingdom.

In another subject the extensor carpi radialis brevior was inserted into the third metacarpal bone by three tendons.

12. The triple insertion of the extensor ossis metacarpi pollicis I have repeatedly noticed, but on several occasions, they have been arranged in a manner different from that usually described.

Sometimes two of the fasciculi passed outwards to the first phalanx, while the other band was connected to the trapezium, or to the metacarpal bone, or to the short abductor pollicis. Again, I found the slips sent, one to the abductor, a second to the opponens, which also was connected by a short recurrent band to the trapezium, while the third was attached as usual to the metacarpal bone.

13. The extensor secundi internodii pollicis I have commonly (about once in every nine subjects) found with a double tendon—the supplementary portion being inserted into the base of the first phalanx, and lying internal to the normal tendon.

14. The abductor minimis digiti I have found on two occasions presenting an anomaly similar to number 14 in Mr. Wood's paper ("Proceedings of the Royal Society," June, 1864), only that in my subjects the deviating muscle was not the flexor brevis, but the abductor, which arose by two heads—one a superficial and external, from the tendon of the palmaris longus and fascia of the forearm, about an inch in one subject, and three inches in another, above the anterior annular ligament. This portion crossed the ulnar artery and nerve, covering the flexor brevis, from which it was quite distinct. The deeper or normal head of this muscle united with the superficial in one case by fleshy fibres at the wrist, but in the other by a tendon near the fingers, both being inserted in common into the inner side of the first phalanx of the little finger.

Though I have never seen a similar arrangement of this muscle in any animal, yet a somewhat corresponding slip has been described, and I have seen the same appearance in connexion with the abductor pollicis in the *Cynocephalus porcarius* and other Quadrumana. It has been suggested that these varieties might be modifications of the palmaris secundus or accessorius before alluded to.

15. The palmar lumbricales I have found to vary very frequently in their origin, principally by the occurrence of additional heads from the inner sides of the neighbouring tendons. This variety occurrred to the second lumbricalis in one instance, and to the second and third in another. The third is by far the most frequent subject of variety, as I have seen two irregularities of that muscle for every single instance of variation in the others.

16. An aggravated case of talipes varus, occurring in the foot of a female subject, exhibited some rare and interesting varieties in the positions, attachments, and relations of some of the tendons about the ankle. The peronæus longus on the right side, after winding around the outer malleolus, grooved the external side of the os calcis, being bound down by a strong double external annular ligament. It then passed forwards, inwards, and a little upwards, soon splitting into three tendons, which were inserted into the tarsal extremities of the metatarsal bones of the fifth, third, and first toes. There was no sesamoid tubercle or cartilage where it wound round the calcis, but a very strong expansion of the calcaneo-cuboid ligament held it in its place. On the left side, although the foot was distorted, the muscle had only its normal insertion. The chief feature of interest in the variety arises from the fact that in the upper extremity the flexor carpi ulnaris, which is the undoubted homotype of this muscle, assumes a somewhat similar mode of arrangement in some animals, as in the striped hyena, where, from the pisiform attachment of this tendon (the homotype of the sesamoid bone, so frequently existing in the tendon of the peronæus longus), four slips are continued to the four outer metacarpal bones. I have seen the same arrangement in a seal. In the *Ursus arctos* a ligamentous slip of a similar nature seems likewise to continue the insertion of the muscle from the pisiform to the fifth metacarpal bone. In the porcupine and some other rodents, the peronæus longus sends slips to the first, second, and third metatarsal bones, as well as to the cuneiforms.

17. In the same subject the tibialis anticus, after gliding over the anterior surface of the tibia, and passing under the anterior annular ligament split into two portions—one of which, a round internal slip, was inserted into the inner side of the scaphoid and ento-cuneiform bones; while the other, broad and aponeurotic, passed externally, to be attached to the outer side of the astragalus and os calcis. Beneath this expansion, and winding round the former round tendinous slip as a pulley, the tendons of the extensor digitorum longus and extensor hallucis proprius ran, turning backwards, inwards, and upwards, so as to form an angle of sixty degrees.

18. The peronæus tertius, in a stout female subject, sent a strong

slip inwards, which united with the short extensor tendon of the little toe. In the leg of a thin subject, also a female, a second peronæal slip arose from the outer side of the long extensor tendon of the little toe, and was inserted in front of the normal peronæus tertius into the fifth metatarsal bone, and likewise by a thin but strong expansion into the base of the fourth metatarsal bone (peronæus quartus).

19. The plantaris tendon in one instance terminated about the middle third of the back of the leg by expanding into a flat aponeurotic lamina, separating the solæus from the gastrocnemius, and terminating by being continuous with the deep tibial fascia at the inner border of the former muscle; the outer edge united with the conjoined tendons of the muscles of the calf. The facility with which the plantaris tendon can be unravelled and expanded is very striking, but I have never seen a natural expansion of it except in this case: in another instance this tendon, for the lower two-thirds of the leg, was inclosed in a canal in the solæus tendon, from which, however, it was quite separate.

20. From the back of the lower extremity of the femur, about a quarter of an inch external to the line leading from the inner condyle to the linea aspera, there arose a round fleshy mass, more than an inch above the inner head of gastrocnemius, which descended, crossing over the poplitæal nerve, to be inserted by a short tendon into the outer head of the gastrocnemius muscle, near the point of its convergence with the inner head (Plate IX., fig. 1, *f*). If we are to recognise in the gastrocnemial series of muscles the representatives of the convergence of the pronator and supinator muscles of the upper limb, this band might be the representative of the upper origin of the long supinator.

21. A composite special muscle to flex the little toe in the foot of a slight female was made up of the following elements:—1st, a muscular band from the posterior part of the os calcis, below the sustentaculum, and above and internal to the musculus accessorius; secondly, a slip from the cuboid and sheath of the peronæus longus; and, thirdly, a small thread from the long common flexor. These three parts united to form a single tendon, which ran to be inserted without splitting into the last phalanx of the little toe. A separate flexor brevis existed for this toe in the third layer of muscles.

22. In another female subject the outer slip of the musculus accessorius detached a long flexor tendon for the little toe, which split the fourth tendon of the flexor brevis, the latter being of extreme minuteness. Nearly the same arrangement was seen in another female, where the outer part of the accessorius formed two tendons, one of which united to the flexor digitorum longus, while the other passed to the little toe direct, only receiving a slender thread from the last-named muscle.

I may here record the occurrence of sesamoid bones which I have found in the heads of the gastrocnemius, in the peronæus longus (not unfrequently), in the tibialis anticus rarely, and in the tibialis posticus.

The biceps flexor cruris in the lower limbs of a male subject arose not only by their long heads from the tuber ischii, but these were continued upwards and backwards over the great sciatic ligament to the side and lower border of the sacrum.

IV. Abnormalities of coalescence may occur in two ways—either by the fusion, more or less complete, of the opposed margins of neighbouring muscles, or by the presence of connecting bands, uniting muscles which typically are distinct. The latter mode of connexion is the more frequently met with; but the two varieties often merge into each other. The former I have seen in the following muscles:—

1. The anterior belly of digastric and its fellow of the opposite side I have seen to unite, so as to form one mass of interlaced muscular fibres, either closely united to the mylo-hyoid, or in other instances separated from it. This arrangement is the normal state in *Inuus sylvanus*, and in a few other species of Quadrumana. A partial form of this variety I have also seen, in which the left anterior belly sent a very large fasciculus below the chin to the median line, there to be inserted into the fascia.

2. I have in one instance found the anterior belly of digastric, on the right side, inseparably connected to the mylo-hyoid of its own side, with which its fibres interlaced.

3. The two genio-hyoid muscles several times were absolutely inseparable, there being no trace of the usual cellular raphe between them. The same mode of fusion is the usual arrangement in the motor uvulæ.

4. The trapezius and deltoid have been in my experience several times united by tendinous and fleshy fibres, crossing the spine of the scapula. The complete union of these muscles is very common in the non-claviculate Mammals, especially at their internal extremity.

5. The infraspinatus and deltoid were in one case fused together, as occurs partially in the pig and camel. The union was produced by the lower fibres of the former muscle becoming continuous with the posterior fibres of the latter.

6. The outer border of the clavicular fibres of the great pectoral and the inner edge of the deltoid I have seen partially fused together, especially at their lowest part. The same arrangement I found in Cynocephalus. I have never met with a complete fusion of the above muscles in man, but a case of the kind is described by Koster ("Nederlandsch Archief," 1864).

7. The deltoid and supinator longus muscles were perfectly blended in the left arm of a strong, well-developed subject, so that a band three quarters of an inch broad, and half an inch thick, was continued from the acromion process to the tendon, which was inserted into the rough surface above the styloid process of the radius.

8. The complete fusion of glutæus medius and minimus was one of the rarest anomalies which I have met with. The anterior fibres of these muscles, however, are not unfrequently united together inseparably.

9. The glutæus medius and pyriformis I have not uncommonly found united at their insertion; more rarely I have found their fleshy portions connected; and in one subject the opening for the glutæal artery was the only appearance of the interval which normally separates these muscles. This mode of coalescence I have seen in a species of Cebus, *C. apella.*

10. The palmaris longus I have once found coalescing with the flexor digitorum sublimis, as before mentioned. This is the natural arrangement in Cebus.

11. Another variety of coalescence has been previously described as existing between the palmaris longus and the flexor carpi ulnaris.

12. The outer edge of the brachialis anticus was occasionally inseparable from the inner border of the supinator longus; in these cases the musculo-spiral nerve passed in a deep tunnel below the connecting fibres.

13. The deep head of the flexor pollicis brevis manus not unfrequently was inseparable from the adductor pollicis, except at the spot where the deep palmar branch of the radial artery passed between them.

The union of muscles by connecting muscular or tendinous slips is of frequent occurrence, and I have seen it taking place with the following:—

1. The lower border of the great pectoral, and the upper edge of the external oblique, which have been very often so distinctly connected that fibres and fasciculi may be easily traced from the tendon at the bicipital groove to the linea alba at the umbilicus.

2. The coraco-brachialis and brachialis anticus I have found united by some fibres; and this anomaly Meckel has thought of very great importance, as establishing the homotypical place of these muscles, as shall be noticed hereafter.

3. The extensor ossis metacarpi pollicis and primi internodii pollicis were not unfrequently connected by the interchange of muscular or tendinous fibres, and in one case coalesced for their whole extent, except from the groove in the radius to the separate insertions of the two divisions of the tendon. The same occurs in *Inuus sylvanus* and *Cynocephalus porcarius.*

4. The flexor sublimis and profundus often interchange muscular bundles; and,

5. The flexor profundus and flexor pollicis frequently are united by a similar interchange of slips. In one case the flexor tendon for the index finger mainly arose from the flexor pollicis; or, conversely, fibres often run from the flexor profundus to the flexor pollicis.

tative, not of the rectus femoris, but of the hamstrings of the lower extremity; the long head representing, doubtless, the origin of the semimembranosus, which is typically placed nearer to the articulation than either of its congeners, and which also is the more external and most tendinous at its origin. The coracoid, or short head, thus may represent the ordinary long head of the biceps cruris; and the humeral accessory slip in the arm, when present, is the evident homologue of the short head of the last-named muscle. In a few of the Quadrumana I have been able to separate the heads of the biceps in a similar manner.

In this representation of the homotypical relations of the flexors of the leg and forearm it will be seen that I have differed materially from Meckel's theoretical comparison of these muscles; as this anatomist, from the occasional occurrence of a connecting band between the coracobrachialis and the brachialis anticus, has considered that these muscles are parts of a modified representative of the semimembranosus, divided transversely in the midst, and having both its severed ends tacked on to the shaft of the humerus. There are, however, many valid objections to this explanation, as it would make the representative of the semimembranosus to arise internal to the other flexors, which is usually not the case with that muscle; also that it is never united with the biceps at its origin; and, lastly, that it usually arises by a tendon, and not fleshy; besides, as we shall see hereafter, the coraco-brachialis may claim a closer relation to another class of muscles than to the hamstrings.

5. The deltoid muscle is sometimes completely divided into two parts, clavicular and scapular. I never, however, have seen the fission extending in so complete a manner as in the instance described by Meckel, where the clavicular, acromial, and scapular fibres were all perfectly distinct and separate.

6. The coraco-brachialis in a few instances (three or four) was partially divisible into two distinct planes; and in one subject these were perfectly differentiated and separated by the external cutaneous nerve. Of the two laminæ in this instance the superficial was inserted lower down than usual, and arose from the tip of the coracoid process, unconnected with the short head of the biceps; the deeper portion was connected intimately with that muscle. I would look upon this variety as of very great interest in determining the homotypical relations of this muscle, which, I think, we are justified in considering as the representative of the adductor mass in the hinder limb; the upper or shorter part may perhaps represent the adductor brevis, or more probably magnus, while the longer and more superficial element is the evident homotype of the adductor longus. This we learn—1st, from its origin, the diminished homotype of the ischiatic element, and this in a situation where the pubis is obsolete; 2nd, from its relation to the brachial artery; and, 3rd, from its insertion. Among the Mammals we find the coraco-brachialis thus divided in the ornithorhynchus, lemur, bear, and others.

7. The supinator longus and (8) psoas magnus were split into two portions in one subject—the former by the radial nerve, the latter by the anterior crural.

9. I have likewise found the posterior sacral and coccygæal fibres of the glutæus maximus severed from the rest of the muscle, so forming the representative of the agitator caudæ of quadrupeds.

10. The anterior fibres of the glutæus medius were in a few instances severed from the posterior, and formed a strong distinct scansorial muscle.

11. The quadratus femoris was three times split into two parallel portions. I have never seen any further segmentation of this muscle, although Jancke has described a triple division.

12. The trapezius I have found once distinctly divided into two parts: the upper or cranial portion, strong and distinct, arose from the usual situation of the occipital bone, and passed outwards, forwards, and downwards, to the clavicle, forming a distinct occipito-clavicular muscle; the origin of the lower portion extended no higher than the ligamentum nuchæ, corresponding to the spine of the fifth cervical vertebra, and its insertion fell short of the acromion process. A partial attempt at this mode of division I have seen, and I have likewise found this upper or occipito-clavicular muscle to be deficient; perhaps it may be the representative of a distinct element, although so frequently united to the rest of the trapezius.

13. The levator anguli scapulæ I have seen split into three parts, the slips from the transverse processes of the third, fourth, and fifth cervical vertebræ remaining separate as far as the insertion of this muscle.

14. The flexor sublimis digitorum has frequently displayed differentiation to a very considerable extent: in the right forearm of one subject, and in the left of another, it was divided from its origin into two parts, of which the outer was distinctly digastric. Its first belly arose from the inner condyle, and about three inches below ended in a tendon, which, after running for about two inches, formed the second belly, which detached from its lower extremity two tendons for the outer pair of fingers. The inner portion of the muscle also arose from the condyle, but no radial origin was present for it or its fellow; it terminated by tendons for the inner or ulnar pair of fingers. In stenops, Meckel describes the whole of this superficial flexor as being digastric; and it is interesting to find an approach to that condition in the present instance. In two other subjects the flexor sublimis was split into four slips up as far as to within an inch of the inner condyle. No radial head was present in these instances.

15. The subscapularis muscle in the arm of a thin female was split into two portions by the circumflex nerve (Plate VII., fig. 1, *a*): the superficial or inferior part arose by two tendons from the posterior and inferior border of the scapula, and, passing below but on a plane superficial to the remainder of the muscle, was inserted into the capsule of the shoulder and the tip of the lesser tuberosity; this portion did not pierce the capsular ligament.

16. The adductor magnus femoris has been often completely divided into an upper and lower part, the separation occurring sometimes in the situation of the middle perforating branch of the profunda artery. I

have found the same arrangement in the dog, dingo, and several other animals.

17. The flexor brevis pollicis manus was also frequently severed into two perfectly distinct muscles. The same state of perfect differentiation I once saw in the extensor brevis digitorum pedis in the right foot of a female subject.

18. The brachialis anticus I have found in one subject split nearly through to its insertion, the cellular interspace between its heads extending down almost to the elbow. A distinct portion of this muscle I found on one occasion arising from the intermuscular ridge of the humerus.

19. The pyriformis muscle I have seen in different degrees of fission, sometimes the insertions of the two segments being apart; but more commonly two muscular bellies have ended in a common tendon, and a part (usually the peronæal portion) of the great sciatic nerve passed backwards between them.

20. Sometimes the costal fibres of the latissimus dorsi were separated from the iliac portion of that muscle as far as the tendon.

21. The cricothyroid I have once seen split into two parts.

VI. Of our last series of varieties we have two subdivisions—the first comprising those cases in which normal muscles are completely obsolete, and the second including those instances where partial suppression occurs; to these might be added varieties by degeneration; but it would be perhaps more correct to exclude them entirely from our enumeration, as they can have but little bearing upon questions of comparative myology, as being the results of influences acting upon parts which otherwise would have been perfect in their embryonic and developed conditions. Complete suppression I have found in cases of—

1. Platisma myoides; 2. zygomatici, major and minor; 3. levator palpebræ superioris, on both sides of a female subject, in whom there was no sign of ptosis; 4. pyramidalis nasi; 5. trachelo-mastoid; 6. serratus posticus superior, very rarely absent; 7. serratus posticus inferior; 8. sterno-thyroid; 9. omo-hyoid, twice—in one instance on both sides, and in the other a rudiment was visible on the left, while the muscle was completely absent on the right; 10. triangularis sterni; 11. palmaris longus; 12. lumbricales manus, and in one case lumbricales pedis, except the one for the third toe; 13. pyriformis; 14. psoas parvus, so frequently absent, that Theile considers it not to be a normal constituent of the human body, although Meckel falls into the singular error of saying that it is not often absent; 15. plantaris more frequently absent than palmaris, in the proportion of three to two; 16. gemellus superior, as mentioned by Gantzer, and as we find in stenops; 17. gemellus inferior, as occurs in the kangaroo and ornithorhynchus; 18. peronæus tertius; 19. transversalis perinæi; 20. transversus abdomini in one instance; 21. palmaris brevis; 22. scalenus anticus; 23. the stylo-hyoid muscle; 24. transversalis pedis; 25. tensor tarsi.

Partial suppression I have found to take place regarding—1. The scapular head of the omo-hyoid; 2. the occipital portion of the trapezius; 3. the long head of the biceps; 4. the coronoid head of the pronator teres—this is absent in many Quadrumana; 5. the radial origin of the flexor sublimis, likewise deficient in monkeys; 6. the outer slips of the extensor digitorum longus and of the brevis in the foot; and, 7, the tendon corresponding to the former in the hand; 8. the long flexor tendon for the little toe; and, 9, the short flexor for the same digit; 10. the sternal head of the sterno-mastoid.

Mr. Alexander Macalister, Demonstrator of Anatomy, Royal College of Surgeons, Ireland, also read the following paper:—

Notes of two Undescribed Ligaments in the Human Body.

There are some ligaments in the human body, which, although comparatively distinct, seem to be as yet undescribed by anatomists, as I have sought in vain for a notice of them in most of the standard works on practical anatomy. One of these structures is connected with the scapula, the other with the hip joint. The first, which I propose to name coraco-glenoid (Plate IV., fig. 1, *c*), is a flat fasciculus, of varying strength and distinctness, which passes from het posterior and external aspect of the coracoid process, underneath and sometimes attached to the coraco-acromial ligament, downwards, backwards, and outwards, obliquely, to be inserted into the glenoid ligament, and into the posterior and superior part of the lip of the glenoid cavity; extending backwards and downwards into the neck of the scapula, in one subject so far as to be continuous with the glenoid attachment of Sir A. Cooper's spino-glenoid ligament. To expose this coraco-glenoid band, we require to detach and throw downwards the deltoid muscle from its origin, to cut across and reflect the coraco-acromial ligament; and then, if we divide the supraspinatus tendon, and draw the humerus downwards, and outwards, so as to render the capsule and its coraco-humeral accessory band tense, this structure will be exposed to view. It is connected at its origin with the coraco-humeral ligament, with which its fibres passing from the coracoid attachment decussate; but they are perfectly distinguishable by their difference in direction, as they form nearly a right angle with each other. Its outer border gives attachment to some fibres of the capsular ligament, which rarely I have seen distinctly split by it; its posterior fibres are often continuous with the periosteum at the root of the coracoid process, or else they may be free along their inner edge. At its insertion it crosses the long tendon of the biceps, with which it is in general partly continuous; occasionally it is split into two parts—one extending to the neck of the capula, the other continuous with the biceps tendon. In frequency I have found this structure as constantly present as the spino-glenoid ligament, than which it is often much stronger; and from observations extending over several sessions, I have estimated that in the average of every twenty subjects it occurred very strong in five, weak but distinct in seven, indistinct in five, and absent in three. Its strength I have found to vary within considerable limits; in one instance it was capable of sustaining a weight of sixteen pounds; in the majority of other cases it could not support a pressure of more than three, four, or five pounds, and sometimes it was not sufficiently strong to bear a weight of six ounces.

The second ligament to which I would call attention is a third accessory slip to the capsule of the hip joint (Plate IV., fig. 2). I have usually found this band springing from the upper and outer part of the tuber ischii; its fibres ran outwards, backwards, and a little upwards, crossing over the groove which separates the acetabulum from the tuber ischii, and are inserted into the posterior aspect of the neck of the femur about midway between the trochanters; a ridge sometimes exists in this position; here its fibres are inseparably united to those of the capsular ligament, although comparatively distinct at the ischiatic attachment. This structure is brought into view by raising the glutæus maximus, by reflecting the sciatic vessels and nerves, cutting through and throwing down the quadratus femoris; and then, when we divaricate the gemellus inferior from the obturator externus, it can usually be seen. Its lower fibres are traceable along the upper edge of the tuber ischii, and sometimes are connected with the origins of the hamstring muscles: it is separated from the origin of the semimembranosus by the attachment of the quadratus femoris. Two other accessory ligaments are recognised in connexion with the hip joint—ilio-femoral and pubio-femoral—but this ischio-femoral fasciculus is usually as distinct from the capsule as either of these, and is often much stronger than the last-named; it protects the joint in rotation inwards.

EXPLANATION OF PLATES

TO ILLUSTRATE DR. MACALISTER'S PAPER ON UNDESCRIBED LIGAMENTS.

PLATE IV., Fig. 1. Coraco-glenoid ligament: *a*, Acromion process; *b*, Long head of biceps tendon; *c*, Coraco-glenoid ligament, a well-developed specimen; *d*, Clavicle; *e*, Glenoid ligament.

" Fig. 2. Ischio-femoral accessory ligament, an unusually developed example, right side of male subject.

ILLUSTRATIONS OF DR. MACALISTER'S PAPER ON ANOMALOUS MYOLOGY.

PLATE V., Fig. 1. Rhombo-axoid muscle: *a*, Rhombo-axoid; *b*, Splenius capitis; *c*, Serratus posticus superior; *d*, Levator scapulæ; *e*, Rhomboideus minor; *f*, Rhomboideus major.

" Fig 2. *a*, Mento-hyoid muscle; *b*, Digastric; *c*, Stylo-hyoid; *d*, Mylohyoid; *e*, Stern o-mastoid; *f*, Sterno-hyoid; *g*, Omo-hyoid.

PLATE VI., Fig. 1. *a*, Azygos pharyngei; *b*, Cephalo-pharyngeus; *c*, Stylo-pharyngeus; *d*, Superior Constrictor; *e*, Middle Constrictor.

" Fig. 2. Deep muscles of the front of the neck, the Scalenus anticus and posticus having been removed; *a*, *a*, Scalenus medius, cut and reflected; *b*, Scalenus accessorius.

" Fig. 3. *a*, Crico-thyroideus posticus; *b*, Crico-thyroideus; *c*, Thyroid cartilage; *d*, Cricoid cartilage; *e*, Os hyoides.

Plate VII., Fig. 1. *a*, Subscapularis accessorius; *b*, Circumflex nerve; *c*, Subscapularis; *d*, Teres major.

„ Fig. 2. *a*, Infraspinatus secundus; *b*, Capsular ligament of the shoulder; *c*, Coraco-brachialis; *d*, Biceps.

Plate VIII., Fig. 1. *a*, Palmaris longus; *b*, Palmaris accessorius; *c*, Flexor Carpi Ulnaris; *d*, Pronator Radii teres; *e*, Flexor Carpi Radialis.

„ Fig. 2. *a*, Pronator teres; *b*, Flexor Carpi Radialis; *c*, Palmaris accessorius; *d*, Flexor Carpi Ulnaris.

„ Fig. 3. *a*, Bicipital origin of Pronator Radii teres; *b*, *b*, condyloid origin; *c*, Supracondyloid humeral origin; *d*, Flexor Carpi Radialis condyloid origin; *e*, Coronoid origin; *f*, Flexor Carpi Ulnaris; *g*, Supinator longus; *h*, Belly of Pronator teres; *i*, Triceps; *j*, Biceps; *k*, Brachialis anticus.

Plate IX., Fig. 1. *a*, Semitendinosus; *b*, Semimembranosus; *c*, Biceps Flexor Cruris; *d*, Gastrocnemius; *e*, Plantaris; *f*, Third or middle head of Gastrocnemius.

The Rev. Samuel Haughton, M. D., read a series of communications (in continuation)

On Animal Mechanics.

No. IX.—On the Muscles of the Marsupials.

My observations on the muscles of the Marsupials were made on four Kangaroos, an Opossum, and a Phalanger, which died in the Zoological Gardens of Dublin. One of the Kangaroos was the Giant Kangaroo, a female, which had lived for nine years in the Zoological Gardens, and died in January, 1866, after a fortnight's illness, of paraplegia, produced by cold and damp. The other Kangaroos were Wallabys, two female and one male, which died in 1865–66, of scrofulous disease of the lower jaw, presenting similar symptoms in all, and apparently produced by the damp climate of Dublin, from the pernicious effects of which no care seemed sufficient to protect them. The Opossum (female) was from Virginia, and died in January, 1866, and the Phalanger died in 1864. The stomach of the Opossum contained thirty-four lumbrical worms.

Part I.—Kangaroos.

In describing the muscles of the Kangaroos, I shall refer to them in the following manner:—

a, *Macropus giganteus* (female).
b, *Macropus Vallabiensis* (male).
c, „ „ (female).
c′, „ „ (female).

A.—*Muscles of the Hip Joint.*

1. *M. iliacus*,	a,		1·71 oz.
M. psoas magnus,	a,		0·57 oz.
M. psoadiliacus,	a,		2·28 oz.
,,	b,	1·07	1·04 oz.
,,	c,	1·00	

The *iliacus* takes its origin from the surface of the ilium, marked in Fig. 25, and the *psoas magnus* from the bodies of the last two lumbar vertebræ.

2. *M. pectinæus*,	a,		0·36 oz.
,,	b,	0·20	0·25 oz.
,,	c,	0·31	

This muscle takes its origin from the pectinæal line, behind the spine of the pubis, and acts as one of the depressors of the marsupial bones; it is inserted into the second fourth of the linea aspera.

3. *M. adductor brevis*,	a,		0·25 oz.
,,	b,	0·25	0·21 oz.
,,	c,	0·17	

This adductor takes its origin from the anterior line of the pubis, inside the *adductor magnus*, and is inserted into the upper fourth of the linea aspera. It acts as a depressor of the marsupial bone.

4. *M. adductor magnus*,	a,		5·22 oz.
,,	b,	3·53	2·96 oz.
,,	c,	2·39	

The *adductor magnus* takes its origin from the anterior edge of the pubis, from the base of the marsupial bone, from the symphysis pubis, and from the top of the pubic arch; and is inserted into the whole length of the linea aspera. It acts as a depressor of the marsupial bone.

5. *M. adductor longus*,	a,		3·42 oz.
,,	b,	2·31	1·93 oz.
,,	c,	1·56	

This muscle takes its origin from the anterior two thirds of the pubic arch, and is separable with difficulty from the *adductor magnus*, over which it is folded like the double *adductor longus* in the Emu; it is inserted above the back of the inner condyle into the lower fourth of the femur.

6. *M. obturator externus,*	a,		1·42 oz.
„	b,	0·94	0·80 oz.
„	c,	0·66	

This muscle has a common tendon with *obturator internus.*

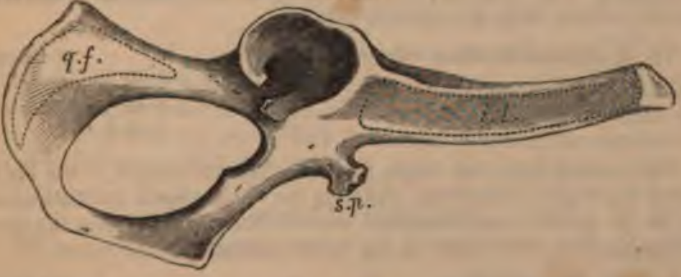
7. *M. Obturator internus,*	a,		0·34 oz.
et gemelli,	b,	0·27	0·29 oz.
„	c,	0·32	

The origin of these muscles is shown in Fig. 26 (*o. i.* and *g.*), where it will be observed that the origin of the gemelli occupies a larger surface of the ischium than is usual in other animals.

8. *M. quadratus femoris,*	a,		1·47 oz.
„	b,	1·02	0·91 oz.
„	c,	0·81	

This is one of the most remarkable muscles found in the Kangaroos, and is intended to assist in the support of the animal when resting in its usual attitude, on the tail and hind legs. It takes its origin from the large triangular surface of the ischium, Fig. 25 (*q. f.*), and, thence converging in a pyramidal mass to a point, is inserted into a special trochanter or tubercle, developed for its reception in the middle of the posterior surface of the femur. Fully two-thirds of this pyramidal mass are composed of tendinous fibres, the remaining third being muscular, so that the whole may be regarded as an elastic tendon. When the animal sits upon its tail and legs in the manner above described, it places its feet so far forward, and its tail so far back, that a mechanical observer is at once struck by the apparent want of strength of the arch on which the weight of the body is supported, and is disposed to come to the conclusion that the act of sitting on its tail must be a fatiguing one to the Kangaroo. Observation of their habits, however, abundantly proves the contrary, and shows that the animal prefers this attitude to any other.

Fig. 25.



The explanation of the difficulty is to be found in the semimembranous *quadratus femoris*, which acts as a "*tie-beam*" to the arch, and, without much expenditure of force, supports the weight of the body placed on the vertex of the straddling arch formed by the tail and hind feet. I do not know of any other animal in which the insertion of the *quadratus femoris* is placed so low down on the femur, nor of any in which, as in the Kangaroo, a special trochanter is provided for this muscle.

9. *M. agitator caudæ*,	a,		5·09 oz.
,,	b,	2·20	1·94 oz.
,,	c,	1·91	
,,	c′,	1·70	

This muscle takes its origin from the sides of the 1st, 2nd, and 3rd caudal vertebræ, and joins the posterior portion of the *glutæus maximus* in a long tendon, which is inserted into the side of the patella and lower margin of the *vastus externus*.

10. *M. glutæus maximus posterior*,	a,		6·06 oz.
,,	b,	2·64	2·01 oz.
,,	c,	1·73	
,,	c′,	1·67	

takes origin from the sacral fascia and from fascia covering *gl. medius*, is separable with difficulty from *gl. max. anterior*, and is inserted by common tendon with the *agitator caudæ*.

11. *M. glutæus maximus anterior*,	a,		2·46 oz.
,,	b,	1·92	1·65 oz.
,,	c,	1·54	
,,	c′,	1·48	

This muscle takes its origin from the anterior margin of the ilium, behind the origin of *sartorius*, and from the lumbar fascia and that covering the *gl. medius*; and is inserted into the fascia flowing over the great trochanter that gives origin to the *vastus externus*.

12. *M. glutæus medius*,	a,		9·47 oz.
,,	b,	2·53	2·71 oz.
,,	c,	2·90	

Origin from the posterior edge of the ilium, from the ischiadic notch forward, and from the surface of that bone, marked in Fig. 26 (*gl. med.*)

13. *M. glutæus minimus*,	a,		0·62 oz.
,,	b,	1·16	0·74 oz.
,,	c,	0·32	

This muscle takes its origin from the surface of the ilium, marked Fig. 26 (*gl. min.*), and is inserted into the line below the head of the great trochanter, by means of a flat tendon.

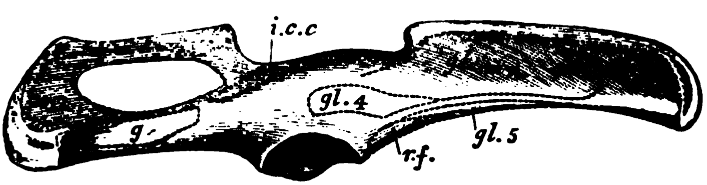
14. *M. glutæus quartus* (*iliocapsularis*),	a,		0·49 oz.
,,	b,	0·39	0·27 oz.
,,	c,	0·16	

This is the muscle described by human anatomists under the name of *ilio capsularis*, as sometimes occurring in the human subject; it belongs to the glutæal group, and not to the iliacal group of muscles, and arises from the surface of the ilium, marked in Fig. 26 (*gl.* 4); and it is inserted by a flat tendon into the prolongation of the insertion of the *glutæus minimus*, with which its action is almost identical.

15. *M. glutæus quintus*,	b,	0·26 oz.

takes origin from the lateral ridge of the ilium, Fig. 26 (*gl.* 5), separating the glutæal from the iliacal surface, and is inserted by flat tendon below *glut. quartus*.

Fig. 26.



16. *M. pyriformis*,	a,		0·44 oz.
,,	b,	0·20	0·18 oz.
,,	c,	0·16	

This muscle is well developed, and is quite distinct from the *glutæus medius*; it has the usual origin, and is inserted partly into the head of the great trochanter, and partly into the fascial origin of the *vastus externus* that flows over that trochanter.

B.—*Muscles of the Knee Joint.*

1. *M. tensor vaginæ femoris*,	a,		0·84 oz.
,,	b,	0·44	0·36 oz.
,,	c,	0·28	

This muscle takes its origin from 1¼ inch of the anterior superior portion of the lateral ridge of the ilium, below the origin of the *sartorius*, and is lost in the fascia directly covering the *rectus femoris* halfway down the thigh. I class it, from its connexion with the *rectus*, among the knee joint, rather the hip joint muscles.

2. *M. rectus femoris*,	a,		4·42 oz.
,,	b,	2·50	1·94 oz.
,,	c,	1·38	
3. *M. vastus externus*,	a,		10·14 oz.
,,	b,	4·30	3·95 oz.
,,	c,	3·60	

This large muscle takes its origin almost exclusively from the glutæal fascia flowing over the great trochanter, and has only a few fibres arising from the side of the femur; and some fibres of the *pyriformis* are attached to its posterior border.

4. *M. vastus internus,*	a,		1·89 oz.
,,	b,	1·42	1·19 oz.
,,	c,	0·96	
5. *M. cruræus,*	a,		1·37 oz.
,,	b,	0·78	0·78 oz.
,,	c,	0·78	
6. *M. sartorius,*	a,		2·71 oz.
,,	b,	1·15	1·12 oz.
,,	c,	1·08	

This muscle has the usual origin, but is inserted subcentrally into the patella, rather on the inner side; it bears a close resemblance to one of the *sartorii* in the Dog.

7. *M. gracilis,*	a,		2·13 oz.
,,	b,	1·16	1·04 oz.
,,	c,	0·92	

This muscle acts as one of the depressors of the marsupial bone, and is inserted by a broad tendinous fascia into the upper third of the leg.

8. *M. semimembranosus,*	a,		1·18 oz.
,,	b,	0·73	0·84 oz.
,,	c,	0·94	

takes its origin from the middle third of the arch of the pubis, and is inserted by a narrow tendon into the top of the tibia; it is with difficulty separable from the *adductor magnus.*

9. *M. semitendinosus,*	a,		4·47 oz.
,,	b,	2·31	2·19 oz.
,,	c,	2·06	

This muscle arises from the tuber ischii, as usual, with a few fibres, forming the posterior border of the *gl. max.* from the first caudal vertebra; and is inserted by a tendon, 1½ in. to 2¼ in. long, into the upper third of tibia, by fascia common to it and to *gracilis.*

10. *M. biceps femoris,*	a,		14·98 oz.
,,	b,	6·62	6·13 oz.
,,	c,	5·64	

The *biceps* is blended, near its origin, with some fibres of the *semitendinosus*, and is inserted into the fascia of the thigh immediately below the great trochanter, into the lower part of the patellar fascia, from one-third to halfway down the leg.

11. *M. poplitæus,*	a,		0·68 oz.
,,	b,	0·27	0·24 oz.
,,	c,	0·20	

C.—*Muscles of Ankle and Foot.*

1. *M. gastrocnemius,*	a,		7·47 oz.
,,	b,	2·68	2·36 oz.
,,	c,	2·04	

Origin; on the outer side, from the back of the outer condyle, from tendon of *agitator caudæ,* and from under surface of one horn of the crescentic sesamoid bone lying below the outer condyle at the top of fibula; on the inner side, from the back of the inner condyle.

2. *M. flexor communis perforatus,*	a,		6·85 oz.
,,	b,	2·62	2·37 oz.
,,	c,	2·11	

Origin; from the inner horn of the crescentic sesamoid bone, with some fibres from the fascia of knee joint and outer condyle.

Insertion; at the calcaneum, the tendon is partly inserted on its inner side, and then passes on over the calcaneum (representing the *flexor brevis digitorum*), and is distributed (as *flexor perforatus*) to the near ends of both phalanges of the two large toes; at the outer side of the heel it gives off a smaller tendon, which runs direct to the *outer* of the large toes, and is joined near its base by a second tendon from the main trunk; both united form the *flex. perforatus* of that toe. It seems to contain the *solæus, plantaris,* and *flexor digitorum brevis* combined in one.

3. *M. flexor communis perforans* (*longus*),	a,		2·61 oz.
,,	b,	1·36	1·24 oz.
,,	c,	1·12	

arises from the upper two-thirds of back of tibia and fibula, except portion covered by *poplitæus;* and is distributed to the ungual phalanges of the four toes.

4. *M. peronæus longus,*	b,	0·20	0·17 oz.
,,	c,	0·14	

takes origin from the top and upper half of the fibula, and from the fascia covering the other two *peronæi ;* and after passing under the foot in the usual manner, its tendon is inserted into the near ends of the metatarsals of the two inner (small) toes.

5. *M. peronæus brevis,*	a,		0·39 oz.
,,	b,	0·12	0·11 oz.
,,	c,	0·09	

Origin from the outer and upper third of fibula, and insertion into outer side of distal end of metacarpal of outer toe, and base of its first phalanx.

6. *M. peronæus tertius,*	b,		0·01 oz.

This little muscle arises from the middle of the fibula, below the other *peronæi,* and is inserted by means of a long silky tendon into the back of the outer and near end of the 1st phalanx of the 2nd toe (small).

7. *M. flexor proprius hallucis*,	b,		0·02 oz.

This muscle arises from the fascia covering the back of the *poplitæus*, with a few fibres running towards the head of the fibula; and is inserted into the os calcis, on the *inner* side of the groove made for the passage of the tendon of the *flexor digitorum perforans*.

8. *M. tibialis anticus*,	a,		4·46 oz.
,,	b,	1·91	1·58 oz.
,,	c,	1·24	

Inserted into the inner side of the near ends of the metatarsals of the 1st and 2nd toes (small).

9. *M. extensor communis digitorum*,	a,		1·23 oz.
,,	b,	0·51	0·43 oz.
,,	c,	0·34	

Distributed to the 3rd and 4th toes (large).

10. *M. extensor hallucis*,	b,		0·02 oz.

This little muscle takes origin from inner side of the head of the tibia, below the *tibialis anticus*, and its tendon, crossing the backs of the metatarsal bones, is distributed by two smaller tendons to the backs of the two inner toes (used chiefly for scratching), of which, with the *peronæus tertius*, it is the proper extensor.

D.—*Muscles of the Shoulder*.

1. *M. trapezius*,	a,		0·42 oz.
,,	b,	0·25	0·28 oz.
,,	c,	0·30	

This muscle is intimately blended with the cutaneous muscles of the neck, with the *omo-atlanticus* and *latissimus dorsi*; it takes its origin from the last three cervical and first six dorsal vertebræ.

2. *M. rhomboideus*,	a,		0·17 oz.
,,	b,	0·18	0·18 oz.
,,	c,	0·18	

Arises from the occiput, from all the cervical, and first three dorsal vertebræ.

3. *M. sterno-cleido-mastoideus*,	a,		0·39 oz.
,,	b,	0·33	0·32 oz.
,,	c,	0·31	
4. *M. omo-atlanticus*,	a,		0·45 oz.
,,	b,	0·25	0·26 oz.
,,	c,	0·26	

Arises from the transverse processes of the 1st, 2nd, and 3rd cervical vertebræ, and is inserted into the anterior fourth of the spine of scapula and whole of clavicle.

5. *M. serratus magnus*,	a,		0·97 oz.
,,	b,	0·88	0·89 oz.
,,	c,	0·90	

Arises from the costal processes (pleurapophyses) and ribs of the vertebræ, from the third cervical to the sixth dorsal.

6. *M. subclavius*,	a,		0·05 oz.
,,	b,	0·05	0·05 oz.
,,	c,	0·05	

This muscle takes its origin from the inner fourth, or cartilage of first rib, and is inserted along the whole length of the under surface of the clavicle.

E.—*Muscles of the Shoulder Joint.*

1. *M. latissimus dorsi*,	a,		1·13 oz.
,,	b,	0·71	0·81 oz.
,,	c,	0·90	

In addition to the *lat. dorsi*, occupying its usual position, there is an accessory cutaneous muscle, like that so fully developed in the Seal and other swimming animals, which is inserted, partly with the *lat. dorsi*, and partly over the *biceps*, with the *pectoralis;* it is, properly, a part of the *panniculus carnosus*, and takes its origin as far down as the symphysis pubis.

2. *M. pectoralis*,	a,		0·95 oz.
,,	b,	1·08	1·16 oz.
,,	c,	1·24	

takes origin from the whole length of the sternum. There is only one pectoral muscle.

3. *M. coracobrachialis*,	b,		0·02 oz.
4. *M. deltoideus*,	a,		0·42 oz.
,,	b,	0·36	0·38 oz.
,,	c,	0·40	

Arises from inner third of spine of scapula and clavicle.

5. *M. supraspinatus*,	a,		0·52 oz.
,,	b,	0·52	0·51 oz.
,,	c,	0·49	
6. *M. infraspinatus*,	a,		0·54 oz.
,,	b,	0·62	0·63 oz.
,,	c,	0·63	
7. *M. teres minor*,	b,		0·03 oz.

Arises from the anterior half-inch of lower edge of scapula, and is inserted below the flat tendon of the *infraspinatus;* its action is the same as that of the *glutæus quartus* (*iliocapsularis*).

8. *M. subscapularis*,	a,		0·69 oz.
,,	b,	0·81	0·79 oz.
,,	c,	0·76	
9. *M. teres major*,	a,		0·24 oz.
,,	b,	0·26	0·31 oz.
,,	c,	0·35	

F.—*Muscles of the Elbow.*

1. *M. triceps extensor*,	a,		1·97 oz.
,,	b,	1·23	1·26 oz.
,,	c,	1·28	
2. *M. anconæus*,	a,		0·09 oz.
,,	b,	0·14	0·08 oz.
,,	c,	0·01	
3. *M. biceps cubiti*,	a,		0·35 oz.
,,	b,	0·39	0·45 oz.
,,	c,	0·51	

This muscle, as in the other Marsupials, is in the Kangaroos composed of two muscles:—

a, *Coracoid biceps*,	0·25
b, *Longhead biceps*,	0·14
	0·39

The coracoid biceps takes its origin from the coracoid, and is inserted into the tubercle of the *radius*, as in man and other Mammals.

The longhead biceps arises from the margin of the glenoid cavity of the scapula, and its tendon passes over the head of the humerus; it is inserted with the tendon of of the *brachiæus* into the *ulna*, as in the Crocodile. The two muscles cross each other in their fibres, like a long **X**, or St. Andrew's cross.

4. *M. brachiæus* (*externus*),	a,		0·33 oz.
,,	b,	0·24	0·30 oz.
,,	c,	0·36	

Arises from the outer and posterior surface of the upper part of the humerus, winding round under the external deltoid ridge, inside the origin of the *supinator longus*.

G.—*Muscles of the Wrist and Hand.*

1. *M. supinator radii longus*,	a,		0·25 oz.
,,	b,	0·09	0·15 oz.
,,	c,	0·20	

The tendon of this muscle is distributed to the near ends of the metacarpals of pollex and index.

2. *M. extensor carpi radialis*, . . b, ... 0·14 oz.
Inserted by two tendons into the distal and radial sides of the metacarpals of index and middle finger.

3. *M. extensor digitorum communis*, b, . . 0·10 } . . 0·12 oz.
,, c, . . 0·14 }

Distributed to the ungual phalanges of the second, third, fourth, and fifth fingers.

4. *M. extensor minimi digiti*, . . b, ... 0·04 oz.

Extends third, fourth, and fifth fingers, and is very distinct from last.

5. *M. extensor carpi ulnaris*, . . b, ... 0·04 oz.
Inserted, as in man, into the outer and near end of the metacarpal of the little finger.

6. *M. extensor ossis metacarpi pollicis*, b, ... 0·09 oz.
Inserted into base of metacarpal of thumb.

7. *M. extensor primi internodii pollicis*, b, ... 0·03 oz.

8. *M. supinator radii brevis*, . . b, . . 0·04 } . . 0·04 oz.
,, . . c, . . 0·03 }

9. *M. pronator radii teres*, . . b, . . 0·10 } . . 0·11 oz.
,, . . c, . . 0·11 }
Inserted into upper third of radius.

10. *M. palmaris longus*, ... c, ... 0·03 oz.

11. *M. flexor carpi radialis*, . . b, . . 0·10 } . . 0·12 oz.
,, . . c, . . 0·13 }
Inserted into base of metacarpal of thumb.

12. *M. flexor carpi ulnaris*, . . b, . . 0·07 } . . 0·07 oz.
,, . . c, . . 0·06 }

Takes its origin altogether from the edge of the ulna and inner side of the olecranon; and is inserted into the pisiform bone.

13. *M. flexor digitorum communis*, b, . . 0·76 } . . 0·67 oz.
,, c, . . 0·58 }

This muscle consists of the *flex. sublimis* and *profundus*, and *flex. pollicis longus*, all combined; the flex. sublimis portion takes an extensive origin from the broad flat tendon of *flex. profundus* and *flex. pollicis* just above the wrist, and having past the wrist, divides into four perforated tendons for the second, third, fourth, and fifth fingers.

14. *M. pronator quadratus*, . . . b, . . 0·02 } . . 0·02 oz.
,, . . . c, . . 0·02 }

Extends the whole length of both radius and ulna.

H.—*Muscles of the Spine.*

The muscles of the spine may be divided into the Direct and Oblique muscles, according as they pass from origin to insertion from and to similar or different processes of the vertebræ.

The Direct muscles are

1. Interspinal,
2. Intercostal,
3. Intertransversal.

The Oblique muscles are

1. Spino-costal, or costospinal;
2. Spino-transversal, or transversospinal;
3. Costo-transversal, or transversocostal.

Direct Muscles of the Spine.

I. *Interspinal Muscles*, passing from spinous process to spinous process, along the line of vertebræ. There are interspinal muscles developed, more or less, along the column, especially in the dorsal and lumbar portions.

II. *Intercostal Muscles.*—The costal processes of the cervical vertebræ are, as usual, well developed; and in the lumbar region they form broad horizontal expansions, which are continued, with modifications down the whole length of the tail.

a, *M. intercostalis lumbaris* (*quadratus lumborum*),
,, c′, 6·08 } . . 6·96 oz.
,, c, 7·83 }

This muscle takes its origin from the interior quadrate surface of the ilium, Fig. 27 (*quad. lumb.*), and from the crest of ilium; and is inserted into the backs of the flat costal processes of all the lumbar vertebræ, into the edge of last rib, and posterior surfaces of next two ribs (extensor of lumbar spine).

b, *M. intercostalis dorsalo-cervicalis*, c′, . . 2·07 } . . 1·67 oz.
,, c . . 1·27 }

From the costal processes of all the dorsals into the backs of the ribs (9 — 1), and of all the cervical costal processes (pleurapophyses), terminating at the mastoid process (extensor of dorsal and cervical spine).

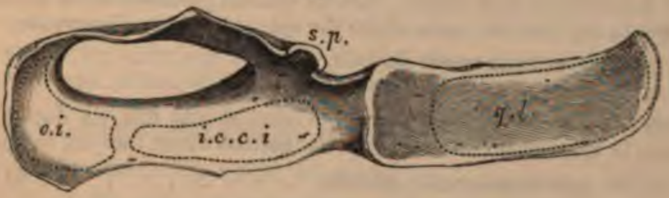
c, *M. intercostalis caudalis superior*, c′, . . 0·68 } . . 0·66 oz.
,, c, . . 0·63 }

This muscle is a horizontal wagger of the tail, and its origin is shown in Fig. 26 (*i. c. c*) from a line on the posterior interior edge of the ilio-ischium; it is inserted into the back of the costal expansion of the sacrum, and into the backs of the costal processes of the caudal vertebræ (1 — 6)—(extensor of caudal spine).

d, *M. intercostalis caudalis inferior*, c′, ... 1·70 oz.

Origin from the inner surface of the innominate bone, marked Fig. 27 (*int. cost. caud. inf.*), and from the adjoining under surface of the costal processes of the sacrum; Insertion, into the under surfaces of the caudal costal processes (1 — 9)—(flexor of the caudal spine).

Fig. 27.



III. *Intertransversal Muscles.*

a, *M. intertransversalis caudalis superior*, c′, ... 2·82 oz.
" c, ... 3·50 oz.

From the tips of the upper transverse processes of the caudal vertebræ (4 — 17, &c.); into the outer sides of the transverse processes of the last dorsal, and all the lumbar, sacral, and caudal vertebræ. This series of muscles fills the space between the superior transverse and costal processes in the tail. In the sacral and lumbar region it lies under the *gl. maximus* and *intercostalis lumbalis*—(extensor of lumbar and caudal spine).

b, *M. intertransversalis lumbalis superior*, c′, ... 0·56 oz.

joining the superior transverse processes of the lumbar vertebræ—(extensor of lumbar spine).

c, *M. intertransversalis caudalis inferior*, c′, ... 1·93 oz.

From the inferior transverse processes (hæmapophyses) of all the caudal vertebræ; into the bodies of the sacral vertebræ, and sides of inferior transverse processes of caudal vertebræ. This series is separated from the *intercostalis caudalis inferior* by the large nerve of the inferior part of tail, which supplies both—(flexor of caudal spine).

d, *M. intertransversalis lumbalis inferior* (*psoas parvus*).

" a, ... 3·70 oz.
" b, ... 2·14 }
" c, ... 1·51 } . . 1·74 oz.
" c′, ... 1·58 }

This muscle takes its origin from the spine of the pubis, and is inserted into the bodies of the vertebræ as high up as the diaphragm—(flexor of lumbar spine).

Oblique Muscles of the Spine.

I. *Spinocostal Muscles* (none).

II. *Spinotransversal Muscles.*

a, *M. spinotransversalis lumbalis* (*multifidus spinæ* ?) c′, . 3·20 oz.

From the backs of the transverse processes of all the vertebræ from the last dorsal to the third caudal; into the spinous processes of the vertebræ in front, and into the *raphe* above the spinous processes (extensor).

b, *M. spinotransversalis dorsalis*, . c′, ... 0·57 oz.
c, *M. spinotransversalis cervicalis*, . c′, ... 0·58 oz.

From the transverse processes of the cervical and first six dorsal (tubercle in front of rib articulation); is inserted direct into the occiput.

d, *M. spinotransversalis caudalis*, . c′ . . . . . . 0·63 oz.

III.—*Costotransversal Muscles.*

a. *M. spinocostalis lumbalis*, ... c, 0·81
(*Sacrolumbalis*), ... c′, 0·88 } . 0·85 oz.

From the anterior crest of the ilium, below the *quadratus* lumborum, into the outer sides of the transverse processes of all the lumbar vertebræ. This muscle acts as a "guy" to the back at either side. It was in a state of fatty degeneration in all the Kangaroos dissected by me.

J.—*Abdominal Muscles.*

1. *M. externus obliquus*, ... a, ... 5·35 oz.

Takes its origin from the lumbar fascia, and from all the ribs, except the first; and is inserted into the whole length of the Marsupial bone, and into the inner edge of the pubis, above the symphysis, and into the edge of the ilium; it is continuous with the *pectoralis* at the extremity of the sternum.

2. *M. cremaster*, ... a, ... 0·38 oz.
,, ... b, ... 0·09 oz.

This muscle is from six to eight inches in length, and forms the lower border of *transversalis*, and takes its origin from the edge of the ilium. During coition it is reduced to two inches in length.

3. *M. transversalis*, ... a, ... 1·60 oz.

Arises from the superior anterior edge of the ilium, from the lumbar fascia, and from the last two ribs; and is inserted into the fascia of the *internus obliquus*.

4. *M. internus obliquus*, ... a, ... 2·63 oz.

Arises from the last two ribs, and from the rib cartilages up to the xiphoid extremity of the sternum; and is inserted into the fascia abdominis.

5. *M. rectus abdominis*, . . . a, ... 3·43 oz.
Takes its origin from the first rib and middle line of the sternum and abdomen (27 inches long); and is inserted into the anterior surface and inner edge of the Marsupial bone, of which it is the proper levator.

K.—*Muscles of Mastication.*

1. *M. masseter externus*, . . . a, ... 0·44 oz.
Arises from the outer and lower portion of the zyzomatic arch, from the lower rim of the orbit and malar bone; and is inserted into the posterior fourth of the lower jaw, including the entire external surface of the marsupial horizontal process.

2. *M. masseter internus et M. temporalis*, . . a, . . 1·11 oz.
Inserted into the outer and inner surfaces of the coronoid process, and into the pit on the outer side of bone.

3. *M. pterygoideus internus*, . . a, ... 0·60 oz.
Takes its origin from the inner side of the pterygoid plate, with some fibres from the outer side, and from the fossa between it and palatal plate; and is inserted into the whole of the inner side of the marsupial horizontal ramus of the lower jaw. The action of this muscle is to push the cutting teeth of the lower jaw upwards and forwards against the upper incisors—an action in which it is powerfully assisted by the external masseter.

PART 2.—OPOSSUM AND PHALANGER.

THE following Tables contain the weights of the muscles of the Opossum and Phalanger dissected by me; and, as I have already entered into so much detail with respect to the muscles of the Kangaroos, it is the less necessary to specify particulars, except in the form of notes.

A.—*Muscles of the Hip Joint.*

	OPOSSUM.	PHALANGER.
	Oz. Av.	Grs.
1. Psoas magnus,	0·10	95
2. Iliacus,	0·11	
3. Pectinæus,	0·04	10
4. Adductor brevis,	0·12	—
5. ,, magnus,	0·22	88
6. ,, longus,	—	44
7. Obturator externus,	0·09	70
8. ,, internus, &c.	0·04	
9. Quadratus femoris,	0·02	
10. Agitator caudæ,	0·09	50
11. Glutæus maximus,		45
12. ,, medius,	0·15	125
13. Pyriformis,	0·02	
14. Glutæus minimus (distinct, though small),		20

B.—*Muscles of the Knee Joint.*

	OPOSSUM. Oz. Av.	PHALANGER. Grs.
1. Rectus femoris,	0·12	220
2. Vasti,	0·27	
3. Sartorius,	0·05	24
4. Gracilis,	0·11	60
5. Semi Membranosus,	0·16	150
6. Semi Tendinosus,	0·08	77
7. Biceps femoris	0·15	110

N. B.—The *Psoas parvus* in Phalanger weighed 33 grs.

C.—*Muscles of the Ankle and Foot* (OPOSSUM).

	Oz. Av.
1. Gastrocnemius et Solæus,	0·09
2. Plantaris,	0·02
3. Flexor dig. longus (perforans), (Distributed to five toes).	0·06
4. *Tibialis posticus,* (Inserted into near and inner side of the metatarsal of hallux).	0·02
5. Flexor hallucis longus, (Inserted into tarsal bones of hallux).	0.02
6. Peronæus longus,	0·03
7. Tibialis anticus,	0·03
8. Extensor dig. communis, (Four tendons).	0·01
9. Extensor hallucis, (Inserted into near end of first phalanx of hallux).	0·01

D.—*Muscles of Shoulder* (OPOSSUM).

1. *M. trapezius,* . . . . 0·25 oz.

Arises from the occiput, all the cervical, and all the dorsal vertebræ, except last; inserted into outer half of clavicle, acromion, whole spine of scapula, and vertebral edge of same.

2. *M. rhomboideus,* . . . . 0·07 oz.

Origin; occiput and spines of all the cervical and first six dorsal vertebræ.

3. *M. sterno-cleido-mastoideus,* . . . . 0·07 oz.

Origin from top of sternum and inner third of clavicle.

4. *M. omo-atlanticus,* . . . . 0·03 oz.

Arises from anterior fifth of spine of scapula; and is inserted into the transverse wing of the atlas.

5. *M. serratus magnus,* . . . . 0·23 oz.

Cervical vertebræ, 2—7; and ribs, 1—8.

6. *M. levator anguli scapulæ,* . . . . 0·02 oz.

Origin; from under surface of the wing of the atlas. Insertion; into the end of the spine of the scapula.

7. *M. omo-hyoideus*, ... 0·03 oz.

Origin; from the anterior point of vertebral edge of scapula. Insertion; usual.

8. *M. subclavius*, ... 0·01 oz.

Origin; from sternal end of first rib. Insertion; under surface of outer third of clavicle, and front of acromion.

E.—*Muscles of Shoulder Joint* (Opossum).

1. *M. latissimus dorsi*, ... 0·23 oz.

Origin; from the spines of (7—13) dorsal vertebræ, and from lumbar vertebræ by fascia. Insertion; beneath biceps by a tendon *distinct* from that of *teres major*; this tendon also gives origin to a fourth head of *triceps*, which is inserted into tip of olecranon and fascia of back of forearm.

N.B.—There is also an accessory cutaneous *lat. dorsi*, elliptical in shape, near the inner margin of, and inside, the true *latissimus dorsi*; its inner border reaches to the *pectoralis minor*. This muscle weighed 0·09 oz., and was inserted into the pectoral ridge of humerus, by fascia, and in line with insertion of *pectoralis minor*.

2. *M. subscapularis*,	0·14 oz.
3. *M. pectoralis minor* (long slip),	0·08 oz.
4. *M. pectoralis major*,	0·28 oz.
5. *M. coracobrachialis*,	0·01 oz.
6. *M. deltoideus*,	0·13 oz.

Origin; from the outer third of clavicle, acromion, and whole spine of scapula. Insertion; into the inner side of the pectoral ridge, outside *biceps*.

7. *M. supraspinatus*,	0·14 oz.
8. *M. infraspinatus*,	0·10 oz.
9. *M. teres major*,	0·08 oz.

F.—*Muscles of the Elbow.*

1. *M. triceps extensor cubiti*, ... 0·42 oz.

The fourth slip from *lat. dorsi* weighs 0·02 oz.

2. *M. anconæus*,	0·01 oz.
3. *M. biceps cubiti*,	0·09 oz.

This muscle is double, as in the Kangaroos—

1. *Coraco-radial*,	0·06 oz.
2. *Ulno-scapular*,	0·03 oz.

4. *M. brachiæus* (*externus*), ... 0·06 oz.

From upper and outer surface of humerus, outside deltoid ridge.

Takes its origin from the lower border of the ilium (postacetabular), and from the upper margin of the ischium, round the ischiadic foramen, and from the membrane of that foramen (*y*), Fig. 28, *ad. mg.* The greater part of this muscle $\left\{\begin{matrix}2\cdot7\\4\cdot7\end{matrix}\right\}$ 3·7 oz., is inserted by a strong flat tendon into the top of the linea aspera; and the rest is digastric (becoming tendinous as it passes behind the hip joint), and inserted into the linea aspera of the upper half of the thigh, as far down as the commencement of the *M. semi-membranoso accessorius;* it overlies the *adductor longus.*

6. *M. obturator externus*, ... ,, ... $\left.\begin{matrix}1\cdot4\\1\cdot7\end{matrix}\right\}$ . . 1·55 oz.

This muscle (which probably corresponds with the *obturator externus* of Mammals) arises from the *inner* surface of the bony rim of the ischiadic foramen (*y*), and its tendon passes with that of the *obturator internus* through the obturator tendinal foramen (*x*), and is inserted, after receiving the tendon of the *posterior gemellus*, No. 7, into the lower depression (Fig. 29. *o. e.*), marked on the outer side of the head of the femur.

7. *M. gemellus posterior*, ... ,, ... $\left.\begin{matrix}0\cdot15\\0\cdot20\end{matrix}\right\}$ . . 0·18 oz.

Origin very small, and near the acetabulum, from the outer side of the head of the obturator membrane (*z*). Both *gemelli* are found in the Emu; the *posterior* attaching itself to the tendon of the analogue of the *obturator externus*, and the *anterior* to the tendon of the true *obturator internus.*

8. *M. adductor longus*, ... ,, ... $\left.\begin{matrix}2\cdot1\\3\cdot4\end{matrix}\right\}$ . . 2·75 oz.

Arises from the lower border of the ischium (Fig. 28, *ad. l.*), below the inferior margin of the *adductor magnus;* and is inserted into the inner edge of the condyloid pit of the femur, and into the crucial ligament of the inner condyle. This muscle was originally double, and is folded on itself; its fibres were pale and fatty in both specimens.

9. *M. obturator internus*, ... ,, ... $\left.\begin{matrix}2\cdot5\\3\cdot3\end{matrix}\right\}$ . . 2·90 oz.

Arises from the inner side of the bony rim of the obturator foramen (*z*), and from its membrane, and is inserted (Fig. 29, *o. i.*) into the upper depression at the top of the back of the outer side of the head of the femur. The *anterior gemellus* is included in the weight of the *obturator internus.*

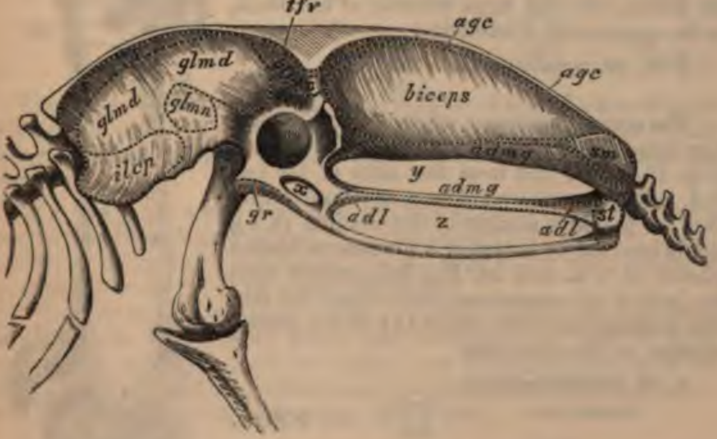
10. *M. agitator caudæ et tensor vaginæ femoris*, ,, $\left.\begin{matrix}11\cdot9\\18\cdot8\end{matrix}\right\}$ . . 15·35 oz.

This combined muscle takes its origin by fascia, from the superior edge of the ilium in front of the acetabular prominence (Fig. 28, *t. f. v.*), and from the superior post acetabular edge of the ilium by fleshy fibres (Fig. 28, *ag. cd.*); and is inserted into the strong fascia overlying the knee on its outer side, and by a fleshy union and common tendon with the *vastus externus.*

The pre-acetabular muscle (*t. f. v.*) weighs .	3·5	. . 4·25 oz.
and is inserted into the fascia of the knee, .	5·0	
The post-acetabular muscle (*ag. c.*) weighs .	8·4	. . 11·10 oz.
,, ...	13·8	

and passes directly into the tendon of the vastus externus.

Fig. 28.



y, Ischiadic foramen. *z*, Obturator foramen. *x*, Tendinal foramen.

11. *M. glutæus maximus*, ...	1·0	. . 0·95 oz.
,, ...	0·9	

The *gl. max.* takes its origin below that of the *ten. fem. vag.* and *agit. caudæ*, by fleshy fibres from a short space in front of and behind the acetabular prominence of the ilium (Fig. 28, *gl. mx.*).

12. *M. glutæus medius*, ...	5·1	. . 5·65 oz.
,, ...	6·2	

The origin and insertion of this muscle are marked in Figs. 28, 29—*gl. md.*

13. *M. glutæus minimus*, ...	0·2	. . 0·20 oz.
,, ...	0·2	

The origin and insertion of this muscle are marked in Figs. 28, 29, *gl. mn.*

14. *M. glutæus quartus* (*ilio-capsularis*), . . 1·1 } . . 1·15 oz.
,, . . 1·2

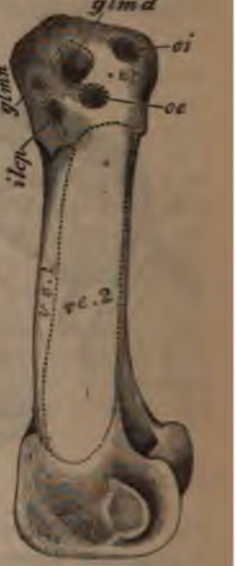
Origin and insertion marked in Figs. 28, 29, *il. cp.*

B. *Muscles of the Knee Joint.*

1. *M. biceps femoris*, ... 9·4 } . . 10·90 oz.
,, ... 12·4

Takes its origin from the large concave post-acetabular surface of the ilium, marked in Fig. 28; and is inserted by a round tendon passing through a looped pulley placed at the inner side of the outer head of *gastrocnemius* and outer condyle of the femur, into the large tubercle of the fibula, at its upper point of trisection.

Fig. 29.



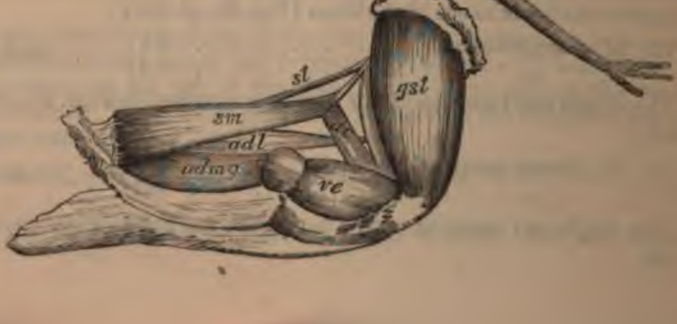
2. *M. semimembranosus*, 4·4 } . . 5·80 oz.
,, 7·2

The *semimembranosus* arises from the posterior margin of the ilium, adjoining the ischium (Fig. 28, *s. m.*), and from the sides of the 1st, 2nd, and 3rd caudal vertebræ; and flows freely over the posterior margin of the ischium (*s. t.*), and is inserted by means of a pinnæform tendon (shown at *s. m.* and *ac.* Fig. 30) formed with the help of the *accessorius*, into a final flat tendon forming one of the heads (β) of the *gastrocnemius*, on the inner side.

3. *M. semimembranoso-accessorius*, . . 0·6 } . . 0·70 oz.
,, . . 0·8

This muscle is shown in Fig. 30, *ac.*

Fig. 30.



Arising from the lower half of the linea aspera, and from the back of condyloid pit at the inner condyle, and inserted into the pinnæform tendon of the *semimembranosus*. It will be observed that the plane of the *semi. m.* lies exterior to those of the *semitendinosus* and *adductores magnus* and *longus*.

4. *M. semitendinosus*, ... 1·0 }
,, ... 1·8 } . . 1·40 oz.

Arises from the posterior ends of the ischium and pubes (Figs. 28 and 30, *s. t.*), and terminates partly in a delicate tendon running into the tendon of the *plantaris*, and partly in a tendon inserted into the side of the tibia (1½ inch down).

5. *M. gracilis* (A), ... 1·0 }
,, ... 1·9 } . . 1·45 oz.
,, (B), ... 0·9 }
,, ... 1·1 } . . 1·00 oz.

There are two muscles in the Emu, neither of which are entitled to be regarded as *pectinæus* or *adductor brevis*, and both present certain analogies with *gracilis*. I shall regard them as *gracilis* (A), and *gracilis* (B).

(A). Takes its origin from the anterior spine of the pubes, and a line two inches in length behind it on the pubes (Fig. 28, *gr.*); and is inserted by a line three inches long into the edge of the inner border of the *vastus internus* (1) at its lower extremity.

(B). This muscle is double headed; one head being supplied from the pubic bone, immediately behind the anterior spine; and the other head taking its origin from the upper inch of the linea aspera of the femur; the tendon of the united muscle is strong and flat, and is inserted into the inner side of the head of the tibia.

6. *M. sartorius*, ... 6·2 }
,, ... 9·4 } . . 7·80 oz.

Its origin is marked Fig. 28, *s. s.*, and its insertion is made by a flat tendon into the inner side of the head of the tibia.

7. *M. rectus femoris* (Qu. *gracilis* (A) or (B)), ... *none.*
8. *M. vastus externus*, No. 1, ... 7·2 }
,, ... 10·0 } . . 8·60 oz.

Takes its origin all round the rim of *vastus externus* (2), which is completely covered by it, and from the surface of the outer front of the femur marked in Fig. 29, *v. e.* 1; and is inserted into the cartilaginous patella, like the ordinary *rectus femoris*, but rather towards the outer side.

9. *M. vastus externus*, No. 2, ... 0·80 }
,, ... 1·20 } . . 1·00 oz.

Takes its origin from the surface marked on the outer side of the femur Fig. 29, *v. e.* 2; and is inserted by means of a strong tendon (passing under the outer head of the *gastrocnemius*, and under the muscular of the *flexor perforatus digiti interni*, and of the *flexor secundus perfor digiti medii*), into the outer tubercle of the tibia. Its tendon of sertion passes over the muscular head of the *flexor perforatus d externi*.

10. *M. vastus internus*, No. 1,	. . . . . .	1·1	. . 1·40
,,	. . . . . .	1·7	

Has an origin similar to that in the Ostrich, and is inserted into inner side of the cartilaginous patella.

11. *M. vastus internus*, No. 2,	. . . . . .	1·5	. . 1·70
,,	. . . . . .	1·9	

This muscle is composed of three distinct parts, occupying lower, middle, and upper thirds of the femur on its inner aspect; th parts terminate in distinct tendons, which cross each other, the up and lower passing to the lateral tubercle and head of tibia next in condyle, while the middle tendon is attached between them to tibia and to the fascia covering the patella.

12. *M. poplitæus*,	. . . .	0·3	. . 0·35
,,	. . . .	0·4	

Inserted 1½ inches down tibia.

C. *Muscles of the Heel and Foot.*

1. *M. gastrocnemius*,	. . . . . .	24·4	. . 28·00
,,	. . . .	31·6	

This muscle consists of four distinct parts—

α,	. . . .	9·6	. . 10·60 oz.
	. . . .	11·6	
β,	. . . .	1·2	. . 1·35 oz.
	. . . .	1·5	
γ,	. . . .	1·1	. . 1·25 oz.
	. . . .	1·4	
δ,	. . . .	12·5	. . 14·80 oz.
	. . . .	17·1	
	Total,	. . . .	28·00 oz.

α. This portion takes its origin from the outer condyle (havi behind its head the pulley through which the tendon of the *bice* passes), and from the fascia covering the patella.

β. This part of the muscle is inseparably connected with the musc accessory to the *semi-membranosus;* and, in a mechanical point view, the *semi. memb.*, and its accessory muscle, aid the *gastrocnemiu* by their insertion into the head of (β), which arises from the inferic prolongation on the femur, of the line of origin of the *accessorius*.

γ. This branch of the *gastrocnemius* arises from the condyloid pit of the femur, by a beautiful round cord-like tendon.

δ. This arises from the whole inner side of the head of the tibia, and from the side of the patella.

2. *M. solæus*, ... 10·0 }
,, ... 13·0 } . 11·50 oz.

Takes its origin from the anterior edge of the fibula, from the outer side of the tubercle of the tibia, from the whole outer surface of the ligamentum patellæ, and from the fascia covering the *tibialis anticus*. Its insertion is double; by a broad tendon into the *ligamentum calcis*, which acts as a patella to the heel, and by a narrower tendon, which, at six inches below the first insertion, is inserted into the outer side of the tendon of the first *flexor perforatus digiti medii*.

3. *M. plantaris*, ... 0·30 }
,, ... 0·21 } . . 0·26 oz.

Arises from the back of the inner cartilage of the knee joint, and is inserted into the inner side of the *ligamentum calcis*, or patella of the heel.

N. B.—The tendon of this little muscle receives a large portion of the *semitendinosus*.

4. *M. flexor perforatus primus digiti medii*, . 1·8 }
,, . 3·1 } . . 2·45 oz.

Arises by two heads, from the patellar fascia covering the outer condyle, and by a long tendon, terminating in the condyloid pit; and is inserted by a perforated tendon on both sides of the distal ends of the first phalanx of the middle toe.

The tendon of this muscle is united by means of a cross slip (intended to produce unity of action) with that of the next muscle, at a point opposite the metatarso-phalangeal articulation.

5. *M. flexor perforatus secundus digiti medii*, 1·3 }
,, 1·6 } . . 1·45 oz.

Arises from the outer side of the ligamentum patellæ, overlying the tendon of *vastus externus* (2); and is inserted by a perforated tendon into both sides of the distal end of the second phalanx of the middle toe.

6. *M. flexor perforatus digiti externi*, . . 1·3 }
,, . . 1·6 } . . 1·45 oz.

Arises, by a double head, from the external ligament of the knee joint, underlying the tendon of *vastus externus* (2), and from the condyloid pit; and is inserted by a perforate tendon into both sides of the distal end of the first phalanx of the outer toe.

N. B.—The tendon of this muscle, before it reaches the heel, passes through the tendon of the second perforate tendon of the middle toe, for a distance of three inches, as if in a sheath.

7. *M. flexor perforatus digiti interni*, . . 0·15 } . . 0·18 oz.
,, . . 0·20 }

This little muscle arises from the outer fascia of the knee joint, overlying the tendon of *vastus externus* (2), and is inserted at both sides of the distal end of the first phalanx of the inner toe.

8. *M. flexor hallucis longus*, ... 0·4 } . . 1·00 oz.
,, ... 0·6 }

Arises from the back of both heads of the *flexor perforatus* of the middle toe, and is inserted on the outer side of the near end of first phalanx of inner toe.

9. *M. flexor communis perforans*, ... 2·4 } . . 3·20 oz.
,, ... 4·0 }

This muscle is formed of two totally distinct muscles, whose separate tendons unite into a common tendon two-thirds down the cannon bone.

α, ... 0·7 } . . 0·90 oz.
. . . . 1·1 }
β, ... 1·7 } . . 2·30 oz.
. . . . 2·9 }
Total, ... 3·20 oz.

α. Arises by a double head from the backs of both condyles of the femur; its tendon passes through a sheath formed in the *ligamentum calcis*, on the outer side of the inferior ridge of the cannon bone.

β. Arises from the whole posterior surfaces of the tibia and fibula, except the portion of the tibia occupied by the *poplitæus*.

N. B.—The united tendon of the *perforans* bifurcates, at the metatarso phalangeal articulation, to the ungual phalanges of all the toes, and at its point of bifurcation a small auxiliary muscle (0·05 oz.) unites the tendon with the posterior border of the sesamoid ligament, under the groove of which the common tendon passes.

10. *M. tibialis anticus*, ... 4·6 } . . 4·85 oz.
,, ... 5·1 }

This muscle is bicipital, and arises from the anterior and outer tubercles of the tibia and the surface of bony ridge joining them; and (as in the Dog and other animals) by a long, beautiful, round rope-like tendon, from the point of the outer condyle, inside the knee joint.

It is inserted into the near end of the cannon bone, in front of the heel, first passing under a " dead eye " ligamental bolt on the front of the tibia.

11. *M. extensor communis digitorum longus*, 1·2 } . . 1·30 oz.
,, 1·4 }

Arises from the front of the tibia, on the outer side of the ridge running down from the anterior tubercle, and is inserted by tendons distributed to the ungual phalanges of all the toes, and to the tendinous sheath of the first phalanx of the middle toe.

12. *Flexor digitorum brevis et abductor digiti*
externi, ... 0·1
,, ... 0·1 } . . 0·10 oz.

The *flexor brevis* arises from two inches of the outer and back surface of the near end of the cannon bone, and unites with the *abductor* by a long slender tendon running the whole length of the cannon bone; the *abductor* arises from the outer and under side of the distal end of that bone, for a space of 1½ inch, marked off by a slight bony ridge; and the common tendon is inserted into the outer side of the near end of the first phalanx of the outer toe.

13. *Abductor hallucis et extensor digitorum*
brevis, ... 0·2
,, 0·2 } . . 0·20 oz.

These muscles are inseparable; and the *abductor* arises from an inner surface of the under and distal end of the cannon bone, marked off by a slight bony ridge, like that of the *abductor minimi digiti,* while the *extensor* takes its origin by a thin sheet of muscular fibres from the whole breadth of the upper surface of the distal end of the cannon bone, for the space of one inch.

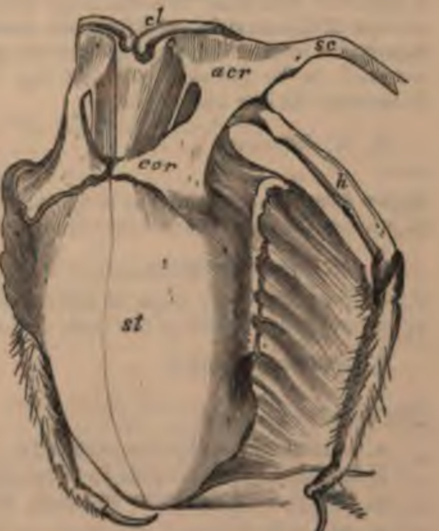
D.—*Muscles of the Wings.*

The anterior limbs in the Emu are much smaller than in the Ostrich and Rhea, and are hidden almost completely by the plumage. The following sketch (Fig. 31) gives a very good idea of the relative proportions of the bones of the wing and sternum; and in it, the initial letters indicate the parts.

1. *M. trapezius,*
0·27
0·28 } 0·28 oz.

Takes its origin from the first, second, and third ribs, and subcutaneously, from the skin covering them; and is inserted into the clavicle, acromion ridge, and anterior two-thirds of the scapula. Its posterior fibres slant forwards.

Fig. 31.



sc., Scapula.
cl., Clavicle.
acr., Acromion.
cor., Coracoid.
st., Sternum.
h., Humerus.

2. *M. rhomboideus*, ... 0·12 }
,, ... 0·11 } . . 0·12

Arises from the third rib, and space between it and second rib; an
inserted into the under surface of the posterior third of the scapu
its fibres slant backwards.

3. *M. latissimus dorsi et teres major*, ... 0·13 }
,, . . . 0·15 } . . 0·14

Occupies its usual position, passing over the posterior border of
scapula, and has also a subcutaneous origin; the *lat. dorsi* arises fr
the fourth rib, and forms the posterior slip of the whole conjoin
muscle; the *teres major* arises from the outer side of the posterior
of the scapula. These muscles are inserted by a common tendon i
their usual place at the back of the humerus.

4. *M. pectoralis* (*major et minor*), ... 0·05 }
,, ... 0·09 } . . 0·07

This sheet of muscle takes origin from the front and edge of
sternum and from the sternal ribs (two inches), and has the usual
sertion; it is an *adductor humeri*.

5. *M. pectoralis secundus*, ... 0·09
,, ... 0·04 . . 0·065

Arises in a thin sheet from the lower border of the acromion, from
surface of the clavicle, and from the coraco-clavicular membrane,
terminates in a tendon passing over the groove in the upper end of
coracoid, to be inserted into the top of the pectoral ridge of
humerus;—it is a *levator humeri*.

6. *M. deltoideus*, ... 0·05 }
,, ... 0·08 } . . 0·065

Arises from the acromial end of the scapula, at the coraco scapular li
of junction, and is inserted into the outer side of the pectoral ridge.

7. *M. coraco-brachialis*, ... 0·05

Arises from the outer edge of the coracoid, and is inserted into
upper and inner fourth of the back of the humerus.

8. *M. triceps humeri*, ... 0·05 }
,, ... 0·08 } . . 0·065

Has three heads—

- *α*. cutaneous (*panniculus carnosus*).
- *β*. long head from scapula in usual place.
- *γ*. fleshy, from the inner and back side of the humerus.

9. *M. supra et infra spinatus*, ... 0·01 }
,, ... 0·01 } . . 0·01

Arises from one inch of the lower edge of scapula, close to glenoid, a is inserted into the inner side of the back of the head of the humerus, in front of the insertion of the *subscapularis.*

10. *M. subscapularis,*	0·01 0·01	0·01 oz.

Origin from the inner and lower border of the scapula, half an inch from glenoid; inserted into the top and back of the inner side of the head of the humerus, inside the insertion of the *spinati.*

10. *M. serratus magnus,*	0·14 0·09	0·115 oz.

Arises from second and third ribs in the usual manner, and is inserted as usual.

11. *M. biceps humeri,*	0·01 0·04	0·025 oz.

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, read the following paper:—

NOTES ON ANIMAL MECHANICS.

No. XI.—MUSCULAR ANATOMY OF THE RHEA (*Struthio Rhea*).

I AM indebted to Mr. Thomas Moore, Curator of the Derby Museum of Liverpool, for the opportunity of dissecting the Rhea, which forms the subject of this notice. It was a male bird, and seemed to be in good condition.

A.—*Muscles of the Hip and Knee Joints.*

1. *M. psoas magnus,*	*none.*
2. *M. iliacus,*	*none.*
3. *M. pectinæus,*	0·12 oz.

Arises immediately in front of the acetabulum (Fig. 32, *p.*), and is inserted into the top of the linea aspera.

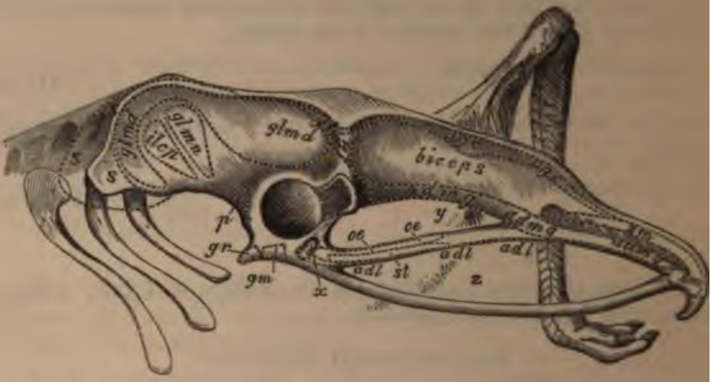
4. *M. adductor brevis,*	*none.*
5. *M. adductor magnus,*	2·60 oz.

Arises from the lower border of the ilium, forming the upper margin of the ischiadic foramen, *y* (Fig. 32), and the prolongation of this bone backwards in conjunction with the ischium (Fig. 32, *ad. mg.*); it is partly inserted into the top of the linea aspera, and partly into the tendon of the *semimembranosus* that is attached to the femur; the tendinous slip that joins these muscles helps them both to pull on the same tendon at the back of the femur.

6. *M. obturator externus*, ... 0·51

Arises from the upper margin of the anterior half of the ischi (Fig. 32, *o. e.*), and from the membrane of the ischiadic foramen,

Fig. 32.



x, Tendinal foramen. *y*, Ischiadic foramen. *z*, Obturator foramen.

is inserted by means of a strong tendon (Fig. 33, *o. e.*) into the back the outer side of the head of the femur, behind the *glutæus medius.*

7. *M. obturator internus*, ... 2·25
8. *M. gemellus anterior*, ... 0·08

Arises from the point marked (Fig. 32, *gm.*) in front of the tendi foramen *x*; and is inserted into the back of the femur (Fig. 33, behind the tendon of the *M. obturator*.

9. *M. adductor longus*, ... 1·00

Arises by fascia from the anterior two-thirds of the lower border of ischium (Fig. 32, *ad. l.*), and is inserted into the lower half of the li aspera and into the tibia.

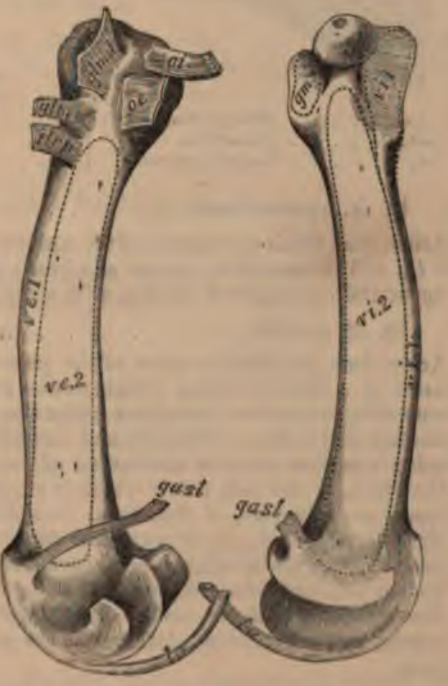
N. B.—This muscle is double; its posterior portion weighs 0·14 and is inserted into the lower third only of the linea aspera; the an rior portion is inserted as above described.

10. *M. agitator caudæ et tensor vaginæ femoris*, ... 6·02

Arises by slip of fascia from the præ-acetabular edge of the ilium ov lying the posterior portion of the *glutæus medius*, and from the p acetabular edge of the ilium overlying the *biceps femoris*. It is inser partly by fascia into the outer side of the patella, and partly into lower margin of the *vastus externus* (1).

11. *M. glutæus maximus*, ... 0·23 oz.
Arises from the line marked (Fig. 32, *gl. mx.*) at the acetabular prominence of the ilium.

Fig. 33.



12. *M. glutæus medius*, 2·05 oz.
Its origin and insertion are marked in Figs. 32 and 33, *gl. md.*

13. *M. glutæus minimus*, 0·25 oz.

14. *M. glutæus quartus* (*iliocapsularis*), 0·23 oz.
The origin and insertion of these muscles are marked in Figs. 32 and 33, *gl. mn.* and *il. cp.*

15. *M. biceps femoris*, 3·80 oz.
The origin of this muscle on the postacetabular surface of the ilium is marked in Fig. 32; and it is inserted by the usual pulley at the back of the outer head of the *gastrocnemius* into the tubercle of the fibula.

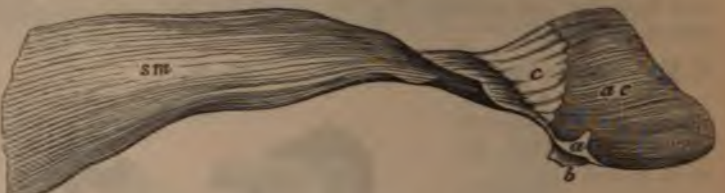
16. *M. semimembranosus*, 2·30 oz.
Arises from the posterior portions of the ilium and ischium (Fig. 32, *s. m.*); and is inserted partly by a tendon into the top of the linea aspera, and partly by a tendon, which is aided (as in the Emu) by an accessory muscle, and which itself has a double insertion by means of two flat tendons into the head of the inner *gastrocnemius*, and into the middle point of the broad insertion of the *semitendinosus* into the tibia.

N. B.—This muscle, as already noticed, is connected with the *adductor magnus* by a tendinous slip.

17. *M. semimembranoso accessorius*, ... 0·50 oz.

This muscle is shown in Fig. 34, and its general arrangement and connexion with the *semimembranosus* are similar to those already described in the case of the Emu.

Fig. 34.



s. m.,	*Semimembranosus.*	*a.*,	Portion of tendon ending in *gastrocnemius.*
ac.,	*Accessorius.*	*b.*,	Portion of tendon ending in tibia.
c.,	Common tendon.		

18. *M. semitendinosus*, ... 0·71 oz.

Arises from the lower margin of the anterior half of the ischium (Fig. 32, *s. t.*), and is inserted by means of a broad tendon into the fascia of the upper and inner part of the leg, with a slip passing on to the heel.

19. *M. gracilis*, ... 0·12 oz.

Arises from the anterior spine of the pubes (Fig. 32, *gr.*), and terminates in a slender tendon which passes over the patella, from within outwards, across the knee joint under the anterior head of the *gastrocnemius* and *solæus*, outwards and downwards to the calf of the leg, being strapped down by the tendon of the *biceps* at its insertion into the fibula, at one inch below which it expands into a fan-shaped tendon spread over the back of the fascia, enclosing the first *flexor perforatus digiti medii* and the *flexor perforatus digiti externi;* this fan-shaped expansion of the tendon of *gracilis* is also connected by means of an auxiliary tendon passing backwards, with the inner side of the head of the second *flexor perforatus digiti medii.* The three tendons of the flexors just named, and so placed in relation with the *gracilis*, pass together into the toes.

N. B.—The *gracilis* muscle in the Rhea performs the mechanical duty assigned by me to the *rectus femoris* in the Ostrich, and serves to bring into simultaneous action all the flexors of the foot and extensors of the leg.

20. *M. sartorius*, ... 2·80 oz.

Arises from the anterior surface of the ilium (Fig. 32, *s. s.*), and from the backs of the last two ribs overlying the *glutæus medius;* and is inserted by a broad tendon into the head of the tibia.

21. *M. rectus femoris*, ... *none.*

22. *M. vastus externus* (1), (Fig. 33, *v. e.* 1), ... 5·07 oz.

Origin and insertion as in Emu.

23. *M. vastus externus* (2), (Fig. 33, *v. e.* 2), ... 0·40 oz.

As in the Emu, with its tendon passing under the head of the *gastrocnemius* to be inserted into the outer tubercle of the tibia.

N. B.—This tendon binds down the tendon of the *gracilis* after it has crossed in front of the knee joint.

24. *M. vastus internus* (1), (Fig. 33, *v. i.* 1), ... 0·95 oz.

Origin and insertion as in the Emu.

25. *M. vastus internus* (2), (Fig. 33, *v. i.* 2), ... 0·95 oz.

Generally as in the Emu, but not so easily divisible into three portions; inserted into the inner head of the tibia.

26. *M. poplitæus*, ... 0·21 oz.

B.—*Muscles of the Ankle and Toes.*

1. *M. gastrocnemius*, ... 11·16 oz.

α, Outer head, as in the Emu, .	2·81
β, Origin from condyloid pit, . .	1·74
γ, Inner head, ...	6·61
	11·16 oz.

γ. This portion of the *gastrocnemius* takes its origin from the back of the inner condyle, from the inner surface of the anterior tubercle, and from the whole head of the tibia, as well as from the side of the ligamentum patellæ.

2. *M. plantaris*, ... 0·50 oz.

Arises from the posterior ligament of the knee joint, on the inner side, and is blended at its insertion with the inner surface of the tendo Achillis formed by the *gastrocnemius*.

3. *M. solæus*, ... 4·12 oz.

Origin and insertion as in the Emu. Its tendon forms the anterior side of the sheath for the tendons of the heel, while the tendon of the *gastrocnemius* forms the posterior side; the secondary slip of the tendon of the *solæus* joins the side of the tendon of the first *flexor perforatus digiti medii* at five inches below the heel joint.

4. *M. flexor perforatus primus digiti medii*, ... 0·74 oz.

Inserted into the near ends of the first and second phalanx of the middle toe.

5. *M. flexor perforatus digiti externi*, ... 0·54 oz.

Inserted into the distal ends of the first phalanx of the outer toe.

6. *M. flexor perforatus secundus digiti medii*, ... 0·27 oz.

Arises from the outer ligament of the knee joint, and is inserted into the near ends of the ungual phalanx of the middle toe.

N. B.—The tendons of the first and second flexor of the middle toe are free in the Rhea, and not united by a cross slip, as in the Emu.

7. *M. flexor perforatus digiti interni*, ... 0·23 oz.

Arises from the fascia covering the inner surface of *soleus*, and is inserted into the near ends of the first phalanx of the inner toe.

8. *M. flexor hallucis longus*, ... 0·10 oz.

Arises from the outer ligament of the knee joint, and is inserted into the near ends of the ungual phalanx of the inner toe, the largest tendon being distributed to the outer side of the toe.

9. *M. flexor communis perforans*, ... 1·22 oz.

This muscle is formed, as in the Emu, of two distinct muscles, whose tendons unite halfway down the cannon bone.

α. This is a double-headed muscle, taking its origin from the backs of both condyles, ... 0·24 oz.
β. Arises from the whole posterior surfaces of the tibia and fibula, ... 0·98 oz.

1·22 oz.

10. *M. tibialis anticus*, ... 1·52 oz.

A two-headed muscle, as in the Emu, taking one origin from the outer and anterior tubercles of the tibia, and another by a round tendon, inside the knee joint, from the anterior surface of the outer condyle of the femur.

11. *M. extensor digitorum communis*, ... 0·63 oz.

Arises from the anterior surfaces of the tibia and fibula, and is inserted into the backs of the ungual phalanges, and into the common sheath of the back of the foot.

C.—*Muscles of the Wings.*

The wing of the Rhea, like that of the Ostrich, which it resembles in so many other respects, is much more fully developed than that of the Emu, as may be seen from the accompanying sketch (Fig. 35).

1. *M. trapezius*, ... 0·08 oz.

Arises from the transverse processes of the last cervical vertebra, and from the first rib, and is inserted into the acromial ridge at the top of the scapula.

2. *M. rhomboideus*, ... 0·02 oz.

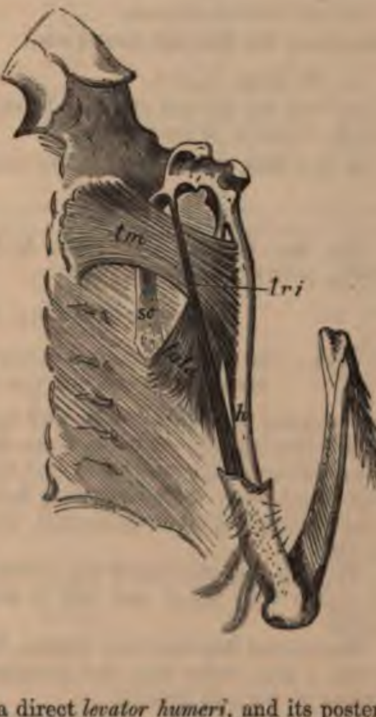
Arises from the side of the third dorsal vertebra, and is inserted into the posterior inch of the back of the scapula.

3. *M. latissimus dorsi*, ... 0·15 oz.

4. *M. teres major*, ... 0·20 oz.

These muscles are very remarkable, and are well shown in Fig. 35 (*lat. d.* and *t. m.*). The *lat. dorsi* takes its origin from the central portion of the fourth rib ($1\frac{1}{3}$ inch), and is inserted into the top and back of the humerus, where it acts nearly as an opponent of the second pectoral, as a depressor of the arm.

Fig. 35.



The *teres major* takes its origin from the spinous processes of the first and second dorsal vertebræ, and from the interspinous ligament, and is inserted broadly (half an inch) into the middle of the deltoidal ridge, lying under the deltoid itself.

5, 6. *M. pectoralis major et minor*, . . 0·27 oz.

Arises from side of top of sternum and from upper sternal ribs, and is inserted into the pectoral ridge of the humerus, and into the sheath covering the *biceps humeri*.

7. *M. pectoralis secundus*, 0·37 oz.

Takes its origin from the coracoid bone, from the top of the sternum, and from the coraco-clavicular membrane; and is inserted into the top of the pectoral ridge.

N. B.—This muscle acts as a direct *levator humeri*, and its posterior fibres are continuous with those of the *deltoideus*, which draws the humerus backwards and upwards.

8. *M. deltoideus externus*, ... 0·36 oz.

Takes its origin from the tip of the acromion, and from three-fourths of an inch of the scapula behind it; and is inserted halfway down the arm, along the back of the deltoidal ridge.

9. *M. coracobrachialis*, ... 0·16 oz.

Arises from the posterior edge of the coracoid, and is inserted into the triangular space lying inside the pectoral ridge on the head of the humerus.

10. *M. triceps humeri* (Fig. 35, *tri*), ... 0·32 oz.

11. *M. supra et infraspinatus,* . . . . 0·08 oz.
Arises from the inferior surface of the whole acromion and top of the scapula, and is inserted into the lesser tuberosity.

12. *M. subscapularis,* . . . . 0·22 oz.
Arises from the whole lower and inner surface of the scapula, and is inserted into the back of the lesser tuberosity.

13. *M. serratus magnus,* . . . . 0·06 oz.
Arises from the first and second ribs.

14. *M. biceps humeri,* . . . . 0·15 oz.
Arises from the tip and posterior border of the coracoid, and is inserted into the tubercle of the radius.

N. B.—This muscle overlies the *coracobrachialis.*

The Rev. Samuel Haughton, M. D., Fellow of Trinity College, Dublin, read the following paper:—

Notes on Animal Mechanics.

No. XII.—On the Muscular Anatomy of the Irish Terrier, as compared with that of the Australian Dingo.

The anatomy of the Dog is so well known, that I have not attempted in the following account to do more than exhibit the relative weights of the corresponding muscles in four typical specimens, and have added a few explanatory notes respecting facts that I have not found recorded in the writings of other anatomists who have described the muscles of the Dog.

The first Dog mentioned was a long-legged Irish Terrier, with about one-eighth Bull blood, and was a well-known fighting dog, of light weight.

The second Dog was very similar, but had not been trained to fight; he was a good water dog, and frequently caught and ate water hens, hunting on his own account.

The third Dog was a Dingo, long resident in the Zoological Gardens of Dublin, and his death was occasioned by his own misconduct; having devoured his four pups for breakfast, he was called to account for his misbehaviour by the mother of the pups, who throttled him on the spot, being persuaded, as some thought, that if she did not anticipate him, he would have proceeded to devour herself next.

The fourth Dog described was a Greyhound bitch, of excellent running qualities.

A.—*Muscles of the Hind Legs.*

It will be seen from a comparison of all the muscles that the Dingo is closely related to the Irish Terrier, but differs widely from the Greyhound.

	Irish Terrier.		Dingo.	Greyhound.
	No. 1.	No. 2.		
	Oz.	Oz.	Oz.	Oz.
1. Psoas, 2. Iliacus,	0·82	0·85	1·12	2·07
3. Pectinæus,*	0·13	0·14	0·23	0·30
4. Adductor brevis,	0·11	0·14	0·25	0·34
5. Ad. magnus,	1·86	2·80	3·50	6·27
6. Obturator externus,	0·16	0·24	0·33	0·47
7. Ad. longus,	1·02	0·98	1·20	3·81
8. Quadratus femoris,	0·09	0·13	0·28	0·21
9. Obturator internus, &c.,	0·24	0·30	0·49	0·62
10. Agitator caudæ et 11. Glutæus maximus,	0·41	0·38	0·84	0·77
12. Tensor vaginæ femoris,	0 73	0 69	0·66	1·90
13. Glutæus medius,	1·40	1·56	2·22	3·38
14. Pyriformis,	0·16	0·20	0·26	0·28
15. Glutæus minimus,	0·17	0·20	0·30	0·35

16. *Gubernator caudæ*, part of the *intercostalis caudalis* (Greyhound), = 0·24 (as in Kangaroo) from interior of ilium behind acetabulum to costal processes of second and third caudals.

1. Biceps femoris,†	2·71	2·85	4·66	7·60
2. M. bicipiti accessorius,‡	—	—	0·10	0·12
3. Semimembranosus,	0·60	0·92	2·05	2·11
4. Semitendinosus,	0·90	1·10	1·81	3·18
5. Gracilis,	0·63	0·78	1·59	2·15
6. Sartorius,§	0·61	0·58 0·19	1·06 0.31	0·44 0·45
7. Rectus femoris,	0·77	0·83	1·42	2·81
8. Vastus externus,	1·50	1·61	3·01	5·01
9. Vastus internus,	0·74	0·87	1·54	2·67
1. Gastrocnemius,	1·21	1·72	2·40‖	1·28 1·87
2. Poplitæus,	0·11	0·11	0·15	0·30
3. Flexor dig. longus,	0·33	0·40	0·59	0·82
4. Flexor hallucis longus,**	0·04	0·06	0·10	0·15
5. Tibialis posticus,††	—	—	0·01	—
6. Flexor dig. brevis (perforatus),	0·01	—	—	—
7. Peronæus longus,	0·11	0·13	0·16	0·27
8. Peronæus brevis,	0·02	0·03	0·03	0·03
9. Peronæus tertius,	0·03	0·02	0·04	0 04

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[*] Inserted into the fascia covering the *vastus internus*.

[†] Inserted into the fascia above the knee, and two-thirds down the fibula, terminating in the *tendo Achillis*, as in the Lion; the posterior fibres form a ribbon-like slip, distinct from the main body of the muscle, and terminating directly in the calcaneum, forming the *M. bicipiti accessorius*.

[‡] Takes its origin from the sacro-ischiadic ligament.

[§] The *sartorius* in the Dog is double; the greater part being inserted one inch down the inner side of the leg, and the lesser part being inserted into the side of the patella; in the Greyhound these parts are equal.

[‖] Outer head, 1·70 oz.; and inner head, 0·70 oz.

[**] Arises from the back of the outer head of the tibia, and is inserted into the side of the broad tendon of the *flex. dig. longus*.

[††] Reduced to a shining tendon, with usual origin and insertion.

	Irish Terrier. No. 1. Oz.	Irish Terrier. No. 2. Oz.	Dingo. Oz.	Gre
10. Tibialis anticus et Extensor hallucis longus,[a]	0·27	0·24	0·42	
11. Extensor digitorum longus,[b]	0·30	0·28	0·37	

B.—*Muscles of the Fore Legs.*

	Irish Terrier. No. 1. Oz.	Irish Terrier. No. 2. Oz.	Dingo. Oz.	Gre
1. Trapezius clavicularis,[c]	0·47	0·49	0·70	0
2. Cleidomastoideus,[d]	0·46	0·47	0·69	0
3. Deltoideus clavicularis,	0·35	0·36	0·81	0
4. Trapezius scapularis,[e]	0·70	0·81	1·43	1
5. Omo-atlanticus,[f]	0·47	0·52	0·96	0
6. Rhomboideus,[g]	0·67	1·05	1·51	1
7. Serratus magnus,	2·23	2·74	3·84	4
8. Sternomastoideus,	0·64	—	1 00	1
9. Deltoideus scapularis,[h]	0·50	0·63	1·05	1
10. Latissimus dorsi,[i]	1·81	2·55	3·43	4
11. Teres major,	0·48	0·70	0·74	1
12. Subscapularis,	0·91	1·08	1·60	2
13. Pectoralis minor,	1·51	2·50	4·15	7
14. Pectoralis major,	0·83	1·10	1·92	1
15. Supraspinatus,	1·26	1·77	2·77	3
16. Teres minor,	—	0·08	0·10	0
17. Infraspinatus,	1·08	1·28	1·94	2
18. Coracobrachialis,	0·07	0·05	0·09	0
1. Triceps humeri,	3·85	4·85	8·23	10·
2. Anconæus,	0·08	0·11	0·15	0
3. Biceps humeri,	0·45	0·48	0·85	1
4. Brachiæus (externus),	0·23	0·33	0·59	0
5. Pronator radii teres,	0·05	0·06	0·12	0·
6. Flexor carpi radialis,[k]	0·07	0·10	0·16	0
7. Flexor dig. sublimis,	0·21	0·25	—	0
8. Flexor carpi ulnaris,[l]	0·31	0·43	0·79	0

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[a] A conjoined muscle, with two appropriate tendons inserted as usual.

[b] Arises by a round tendon inside the knee joint from the anterior surface of the outer cond the femur.

[c] Arises from the occipital ridge, and first to fifth cervical vertebra, and is inserted into the mental line that represents the clavicle.

[d] Arises from the mastoid process, and is inserted into the clavicular ligament.

[e] Arises from the dorsal vertebræ, and is inserted into the spine of the scapula.

[f] Arises from the transverse process of the atlas, and is inserted into the anterior part of the of the scapula.

[g] Including a slip from the occiput, as in the *Macacus nemestrinus*: it takes origin from all th vical vertebræ and anterior half of the dorsal.

[h] Arises from the anterior extremity of the scapular spine, and from the fascia covering the rior portion of the *infraspinatus* = *deltoideus externus* (Cuv.).

[i] Gives origin, near its insertion, to a fourth head of the *triceps*.

N. B.—There is also a cutaneous accessory.

[k] Inserted into the near end of the metacarpal of second finger (index).

[l] Consists of two distinct muscles, with double tendon inserted into the pisiform bone.

	No. 2.	Dingo.
Condyloid head,	0·08	0·12
Olecranon head,	0·35	0·67
	0·43	0·79

	Irish Terrier.		Dingo.	Greyhound.
	No. 1.	No. 2.		
	Oz.	Oz.	Oz.	Oz.
9. Supinator radii longus,[m]	0·34	0·36	0·61	0·70
10. Extensor dig. commun.,[n]	0·12	0·17	0·21	0·30
11. Extensor carpi radialis,[o]	0·04	0·06	0·09	0·09
12. Extensor carpi ulnaris,[p]	0·11	0·16	0·23	0·34
13. Supinator radii brevis,	0·03	0·03	0·07	0·06
14. Flexor dig. profundus,	0·43	0·63	1·02	1·38
15. Extensor oss. met. pollicis,[q]	0·03	0·07	0·08	0·10
16. Pronator radii quadratus,[r]	0·04	0·06	0·11	0·12

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, read the following paper:—

NOTES ON ANIMAL MECHANICS.

No. XIII.—ON THE MUSCULAR ANATOMY OF THE BADGER.

THE muscles recorded in the present Note were observed in two fine specimens of the Badger (*Meles taxus*), male and female, which died in November and December, 1864, in the Gardens of the Royal Zoological Society of Ireland.

A.—*Muscles of the Hind Limb* (Male).

	Grs.		Grs.
1. Sartorius,	235	13. Glutæus quartus (ilio-capsularis),	20
2. Iliacus, 3. Psoas magnus,[s]	231	14. Tensor vaginæ femoris,	70
4. Pectinæus,	70		
5. Adductor magnus,	374	15. Biceps femoris,	517
6. Obturator externus,	110	16. Bicipiti accessorius (as in Lion), (6 inches long, and ribbon-like),	25
7. Quadratus femoris,	44		
8. Obturator internus, et gem.,	77	17. Semimembranosus,	490
9. Glutæus maximus, et agitator caudæ,	88	18. Semitendinosus,	260
		19. Gracilis,	245
10. Glutæus medius,	350	20. Rectus femoris,	250
11. Pyriformis,	40	21. Vastus externus,	385
12. Glutæus minimus,	20	22. Vastus internus,	105
		23. Cruræus,	11

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[m] Inserted into near ends of index and middle metacarpals.

[n] Distributed chiefly to the little and ring fingers.

[o] Distributed below the tendons of the *ex. dig. com.* to the little and ring fingers.

[p] Inserted into the outer and near end of the metacarpal of the little finger.

[q] Inserted into the inner and near end of the metacarpal of the thumb.

[r] Extends along the whole length of the radius and ulna.

[s] *Psoas parvus* = 142 grs.

B.—*Muscles of the Fore Limb* (Female).

	Grs.		Grs.
1. Trapezius et deltoideus clavicularis vel internus,	335	8. Teres major,	94
2. Rhomboideus (with occipital slip),	276	9. Subscapularis,	231
3. Serratus magnus,	473	10. Pectoralis minor,	297
4. Sternomastoideus,	210	11. Pectoralis major,	210
5. Cleidomastoideus,	85	12. Deltoideus scapularis (externus),	88
6. Omo-atlanticus,	100	13. Supraspinatus,	308
		14. Infraspinatus,	228
		15. Triceps humeri,	658
7. Latissimus dorsi,	652	16. Biceps humeri,	90

The Rev. Samuel Haughton, M.D., Fellow of Trinity College, Dublin, read the following paper:—

Notes on Animal Mechanics.

No. XIV.—On the Muscles of the Virginian Bear.

In April, 1865, one of the fine Virginian Bears of the Zoological Gardens of Dublin, a female, having fallen into a depressed condition of health, an abscess appeared under the fascia covering the great trochanter of the right thigh, which she persisted in gnawing at to such an extent as to render her an object very unattractive to visitors to the Gardens. She was accordingly sentenced to death by the Council, and the sentence was carried into execution on the 1st of May, 1865, as follows:—

I gave her 12·4 grs. of pure strychnia, in an apple, at 3·17 P.M., and she was dead at 3·52 P.M., having exhibited the following symptoms:—

1. At 20 minutes after dose, her breathing became distressed (108 in the minute);
2. At 24 minutes, she experienced her first tetanic convulsion, the spasm of which never completely relaxed;
3. At 34 minutes, she seemed to be dead;
4. At 35 minutes, she was completely dead, and her heart had ceased to beat.

A.—*Muscles of the Hind Limb.*

	Oz. Av.		Oz. Av.
1. Iliacus, 2. Psoas magnus,	4·90	8. Obturator internus et gemelli,	1·33
3. Pectinæus,	1·60	9. Glutæus maximus,	4·80
4. Adductor magnus,	14·90	10. Glutæus medius,	6·00
5. Obturator externus,	8·50	11. Pyriformis,	0·95
6. Adductor longus,	2·10	12. Glutæus minimus,	0·45
7. Quadratus femoris,	0·67		

	Oz. Av.		Oz. Av.
13. Biceps femoris, . . .	15·70	18. Sartorius, ...	5·20
14. Semimembranosus, . .	2·70	19. Rectus femoris, . . .	6·40
15. Semitendinosus, . . .	4·40	20. Vastus externus, . .	8·80
16. Gracilis, ...	6·20	21. Vastus internus, . . .	3·40
17. Tensor vaginæ femoris,	2·50	22. Cruræus, ...	0·50

23. Gastrocnemido-solæus, ...	8·10

	Oz.
α. From outer condyle, . . .	4·0
β. From inner condyle, . . .	1·6
γ. From fibula, ...	2·5
	8·10

24. Poplitæus, ...	0·54

Arises by a strong tendon from the outer side of the outer condyle, inside the knee joint, and is inserted into the upper half of the tibia.

25. Flexor digitorum longus,*	2·30
26. Flexor hallucis longus,*	0·53
27. Tibialis posticus, ...	0·38
28. Flexori digitorum longo accessorius, ...	0·12
29. Flexor brevis perforatus, ...	0·11
30. Tibialis anticus, ...	1·22
31. Extensor hallucis, ...	0·11

Inserted into the back and outer side of the first phalanx of the hallux.

32. Extensor digitorum longus, ...	1·31

There are also several slips of the *extensor brevis* arising from the surface of the os calcis, in front of the astragalus.

33. Peronæus tertius, ...	0·17

Inserted into the outer side of the first phalanx of the little toe.

34. Peronæus brevis, ...	0·24

Inserted into the outer side of the base of the metatarsal of little toe.

35. Peronæus longus, ...	0·41

Inserted, after crossing the sole of the foot, into the outer side of the base of the metatarsal of the hallux.

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* The *flexor hallucis* tendon is united to the *flexor digitorum longus* tendon in the sole of the foot.

B.—*Muscles of the Fore Limb.*

	Oz. Av.
1. Trapezius clavicularis,	5·90
2. Trapezius scapularis,	9·20
3. Rhomboideus,	—
4. Cleidomastoideus (rope-like muscle),	1·11
5. Omo-atlanticus,	4·40
6. Serratus magnus,	14·10
7. Latissimus dorsi,	12·50
8. Teres major,	2·50
9. Subscapularis,	6·10
10. Pectoralis minor,	1·06
11. Pectoralis major,	15·80
12. Deltoideus clavicularis,	2·80
13. Deltoideus scapularis,	4·50
14. Supraspinatus,	5·60
15. Infraspinatus,	5·10
16. Teres minor,	0·42
17. Infraspinatus secundus,	1·73
May be regarded as belonging either to *subscapularis* or to *infraspinatus*, and is equivalent to *glutæus quintus*.	
18. Coracobrachialis,	0·68
19. Coracobrachiali accessorius (like the gemelli),	0·33
20. Triceps humeri, including the fourth or *latissimus dorsi* head, which is 1·70 oz.,	21·70
21. Brachiæus (externus),	3·30
22. Biceps humeri,	4·70
23. Supinator radii longus,	0·89
24. Extensor carpi radialis longior,	0·63
Inserted into the base of the metacarpal of index finger.	
25. Extensor carpi radialis brevior,	1·01
Inserted into the base of metacarpal of middle finger.	
26. Extensor digitorum communis,	1·06
27. Extensor carpi ulnaris,	1·16
Inserted in the outer side of base of metacarpal of little finger.	
28. Extensor minimi digiti (auricularis),	0·61
Distributed to the ungual phalanges of third, fourth, and fifth fingers.	
29. Extensor ossis metacarpi pollicis,	1·31
Inserted in the outer side of base of metarcarpal of pollex.	

		Oz. Av.
30. Extensor (secundi) internodii pollicis,		0·34
Inserted into the ungual phalanx of pollex.		
31. Supinator radii brevis,		0·81
32. Pronator radii teres,		1·61
33. Flexor carpi radialis,		1·03
34. Palmaris longus,		1·60
35. Flexor carpi ulnaris,		1·42
36. Flexor digitorum sublimis,	Terminate in a common tendon, which is distributed to the ungual phalanges of the five fingers; and the upper portion of the common tendon, corresponding to that of the *flexor sublimis*, sends a separate thin slip to the index finger, which slip lies above the index branch of the common tendon.	8·40
37. Flexor digitorum profundus,		
38. Flexor pollicis longus,		
39. Pronator quadratus,		0·43
Arises from the lower third of the ulna, and is inserted into the lower fourth of the radius.		

The Rev. Samuel Haughton, M. D., Fellow of Trinity College, Dublin, read the following paper:—

NOTES ON ANIMAL MECHANICS.

No. XV.—On the Muscular Anatomy of the Otter (*Lutra vulgaris*).

In March, 1865, I dissected a very fine male Otter, which had lived ten years in the Zoological Gardens of Dublin, and was well known to all the frequenters of those Gardens, from his playful and docile habits. He died of miliary tubercle, accompanied by pneumonic congestion of both lungs; and his right auricle and ventricle, with the two cavæ and hepatic vein, were filled with clotted blood, the result of the pulmonary obstruction.

This beautiful animal was originally presented to the Dublin Gardens by Dr. Horne, of Ballinasloe, on the 8th of March, 1855, and died on the 27th of February, 1865.

The Council of the Zoological Society have made many attempts to rear young Otters, but their exertions have seldom been rewarded with success, owing to the extreme difficulty of procuring suitable food; for the Otter, although aquatic and piscivorous in its habits, is nursed on mother's milk, in a dry warm nest, for a longer period than most carnivorous animals. As the habits of the Otter in this country, in its wild state, are but little known, I make no apology for inserting in this place the following account of the *Lutra vulgaris*, prefatory to my description of its muscles—an account for which I am indebted to Mr. Robert Montgomery, the Secretary of the Royal Zoological Society of Ireland, who has had many opportunities of studying its habits in a state of nature. I can myself bear testimony to the fact, that when cray fish and salmon in the Barrow are scarce, the Otters that frequent its banks will attack and kill young lambs for food :—

"Otter (*Lutra vulgaris*) belongs to the Family of the Mustelidæ. There are at least five well-ascertained species. In early spring the young are produced, generally two, sometimes more; as many as five have been observed. The fur is of two kinds—one thick, short, and soft, brown with white tips; the other coarser in texture, and longer, and darker in colour.

"Pennant mentions one having been killed of 40 lbs., but 24 lbs. is a very large example in this country. It is quite true that they eat the head and shoulders of fish, leaving the remainder, when fish are plentiful; they are trained in Sweden, and still by a few people in England; they are trained very much in the same way as water dogs are. The muscular system of Otters is very largely developed. Its Irish name is *Madra uisge*, meaning water dog. *Lutra vulgaris* must not be confounded with the great Sea Otter, *Enhydra marina*, which is a much larger animal, and the skin of which is so much valued by furriers. Pallas says he has known one skin to fetch upwards of £20. In Kamtschatka they are called Kalan; they are still numerous on the west coast of America, as far south as California.

"It is found in Vancouver's Island, which island is rich in Otters, producing three kinds—*Enhydra marina*, the Vison (*Putorius vison*), and our friend, called there the Land Otter, as distinguished from Enhydra. The skin of the latter, even at present, in Vancouver's Island, sometimes reaches six feet in length, and is sent to England to be dressed, and fetches from £12 to £15. The chief market is in China, where they bring 100 dollars (American).

"I have known an Otter to kill waterfowl, and I believe they sometimes kill lambs. Female goes with young nine weeks. Mr. Ogilby, so long Secretary to the London Zoological Society, is of opinion that our Irish Otter is a distinct species from the English; but I do not believe he has ever had an opportunity of verifying this opinion by examining and comparing their skeletons; he judged chiefly from differences in their habits.

"R. M."

A.—*Muscles of the Hind Limb.*

	Oz. Av.		Oz. Av.
1. Sartorius, ...	0·30	13. Glutæus minimus, . .	0·08
2. Psoasiliacus, ...	0·25		
3. Pectinæus, ...	0·07	14. Biceps femoris, . . .	0·51
4. Adductor brevis, . .	0·10	15. Bicipiti accessorius, .	0·05
5. Adductor magnus, . .	0·43	16. Semimembranosus, . .	0·49
6. Obturator externus, .	0·07	17. Semitendinosus, . . .	0·24
7. Adductor longus, . .	0·50	18. Gracilis, ...	0·23
8. Quadratus femoris, . .	0·03	19. Quadriceps extensor femoris, ...	1·11
9. Obturator internus et gem.	0·04		
10. Agitator caudæ, . . .	0·06		
11. Glutæus maximus et Tensorvaginæ femoris,	0·32	20. Gastrocnemius, ...	0·61
		21. Plantaris, ...	0·25
12. Glutæus medius et Pyriformis, ...	0·40	22. Solæus, ...	0·01
		23. Poplitæus, ...	0·06

24. Flexor digitorum longus, ... 0·05

Inserted into the common junction of the tendons of *flexor hallucis longus* and *accessorius*. The tendons of this muscle are distributed chiefly to the hallux and index.

	Oz. Av.
25. Flexor hallucis longus,	0·22

This acts in the Otter as a common flexor, and is analogous to the *flexor profundus* of the hand.

26. Tibialis posticus,	0·06
27. Flexor digitorum brevis,	0·02
28. Flexori longo accessorius,	0·01
29. Tibialis anticus,	0·32
30. Extensor digitorum longus,	0·14
31. Extensor minimi digiti,	0·03

Its tendon passes under the groove of the outer ankle, with that of the *peronæus brevis*, and is inserted into the outer side of the ungual phalanx of the little toe.

32. Peronæus tertius,	0·02
33. Peronæus brevis,	0·06
34. Peronæus longus,	0·05

B.—*Muscles of Fore Limb.*

1. Trapezius scapularis,	0·47
2. Trapezius clavicularis,	0·64
3. Sternomastoideus,	0·72

Inserted into the first rib, the top of sternum, and raphe of lower part of neck.

4. Cleidomastoideus,	0·17
5. Omo-atlanticus, No. (1),	0·27

Arises from the anterior surface of the transverse process of the atlas, and is inserted into the anterior third of the spine of the scapula.

6. Omo-atlanticus, No. (2),	0·21

Arises from the anterior surface of the transverse process of the atlas, and is inserted into the posterior third of the spine of the scapula.

7. Serratus magnus,	1·11

In this muscle I have included the *levator anguli scapulæ*, which is quite distinct from *omo-atlanticus* No. 2, and takes its origin from the middle of the occipital line, and is inserted into the vertebral edge of the scapula, immediately above the end of its spine. The remainder of the *serratus magnus* takes its origin from the costal processes of the cervical vertebræ (2 — 7), and from the first seven ribs.*

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* There are fourteen ribs in all.

	Oz. Av.
8. Rhomboideus,	0·35

Arises from the occipital ridge, from all the cervical vertebræ, and from the first two dorsal.

9. Teres major,	0·14
10. Latissimus dorsi,	1·14

Has a double insertion.

a. Connected with the *cutaneous accessory* into the tendon of the *pectoralis minor*, near its insertion, and at its lower border, strapping down the *biceps* upon the bone. Takes origin from the posterior surfaces of the last five ribs.

b. By a tendon common to it and *teres major*, into the humerus, under *biceps*, as usual. Takes origin from the posterior surfaces of the seventh, eighth, and ninth ribs.

11. Subscapularis,	0·65
12. Pectoralis minor,	1·12

Takes origin at sternum from the ribs (4 — 9), and is inserted, strapping down the *biceps* into three-fourths of the length of the humerus.

13. Pectoralis major,	0·72

Takes origin at sternum, from the first four ribs, and is inserted into the outer side of the pectoral ridge of the humerus, and by fascia into the skin of the forearm.

14. Deltoideus clavicularis,	0·10

Inserted into the inner side of the pectoral ridge of the humerus and into the ulna, with the tendon of *brachiæus*.

15. Deltoideus scapularis,	0·12
16. Supraspinatus,	0·45
17. Infraspinatus,	0·21
18. Biceps humeri,	0·16
19. Brachiæus (externus),	0·14
20. Triceps (including fourth head from tendon of *latissimus dorsi*),	1·40
21. Anconæus,	0·05
22. Pronator radii teres,	0·08
23. Flexor carpi radialis,	0·64
24. Palmaris longus,	0·12
25. Flexor carpi ulnaris,	0·10
26. Flexor digitorum sublimis,	0·12
27. Flexor digitorum profundus, 28. Flexor pollicis longus,	0·15
29. Pronator quadratus,	0·02
30. Supinator radii longus,	0·12

	Oz. Av.
31. Extensor carpi radialis,	0·23

Inserted by a bifurcate tendon into the near ends of the metacarpals of index and middle fingers.

32. Supinator radii brevis,	0·02
33. Extensor digitorum communis,	0·05
34. Auricularis,	0·04

Inserted into the little, ring, and middle fingers.

35. Extensor carpi ulnaris,	0·07

Inserted into the near end of the metacarpal of the little finger.

36. Extensor ossis metacarpi pollicis,	0·05
37. Indicator,	0·01

Inserted by a double tendon into the index and middle fingers.

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, read the following paper :—

NOTES ON ANIMAL MECHANICS.

XVI.—ON THE MUSCULAR ANATOMY OF THE RHINOCEROS.

A YOUNG male Rhinoceros, three years old, having died in the Zoological Gardens of Dublin in April, 1865, the body was purchased, for £17, for the Museum of Trinity College, and I availed myself of the opportunity of making a careful examination of his muscles. I was ably assisted in the dissection by Mr. Macalister, Demonstrator in Anatomy of the Royal College of Surgeons, and by a staff of medical students, who relieved each other from time to time. The stench from the decomposing blood was almost intolerable, and several of my assistants were disabled by typhoid diarrhœa; this I escaped myself, as I had done on a former occasion when dissecting a Nylghau, which had died of putrid fever, and whose blood after death seemed to communicate diarrhœa by its smell to almost every person in contact with the body. Notwithstanding these difficulties, I was able to complete the entire muscular dissection in person, the results of which cannot fail to prove of interest to anatomists.

Having made a careful *post-mortem* examination of all the viscera, except the brain, I felt it my duty to lay the following Report before the Council of the Zoological Society :—

"SCHOOL OF PHYSIC, TRINITY COLLEGE,
"*Dublin, April* 14, 1865.

"REPORT ON DEATH OF THE RHINOCEROS.

"The Rhinoceros died at 4 A. M. on Thursday, the 6th inst., and his body was opened in the new Dissecting Room of Trinity College on the 8th inst., at 1 P. M.

"I was assisted in making the *post-mortem* examination by Professor Ferguson and Mr. Connor; there were also present Dr. Alexander Carte, Dr. M'Dowel, Dr. Bennett, Dr. Macalister, and several other anatomists.

"The rectum was protruded through a space of eighteen inches, and in it were two *post-mortem* ruptures; in the ilium, two feet from the cæcum, there was extensive softening, as also at the junction of the duodenum and jejunum; the stomach was filled to distention with a mixture of hay and whole Indian corn, both fermenting, and pervaded with an aldehydic smell, which overcame even the intolerable odour of the gases with which the abdomen was distended almost to the bursting point; the hay was somewhat masticated, but the corn had been bolted whole; numerous tapeworms were found in the upper part of the intestines.

"The decomposition set in with most unusual rapidity, particularly in the anterior extremity, and it was with the greatest difficulty that a few precious fragments of the viscera of this rare animal could be preserved; many of the muscles also dissolved in the course of twenty hours into a mass of putrid jelly. This phenomenon was most marked in the left side of the thorax and left anterior limb.

"CAUSE OF DEATH.

"I believe that death was caused by the improper administration of Indian corn, which fermented in the stomach and intestines, and developed gas to such an extent as to cause prolapsus of the rectum, and that the pressure caused by this gas ultimately destroyed the action of the diaphragm, and so caused death by asphyxia; and I am further of opinion that it is the duty of the Council to institute the most searching inquiry into the manner in which Indian corn was given to this animal, as such food does not appear in the scale of dietary formally prescribed by the Council's order to be used.

(Signed) "Samuel Haughton, *Hon. Sec. R. Z. S.*

"P. S.—The tapeworms were in all probability the cause of the convulsions experienced by the Rhinoceros shortly after his arrival in the Dublin Gardens. "S. H."

A.—*Muscles of the Hind Limb.*

Oz. Av.

1. *Sartorius*, ... 12·5

Origin; from the inner margin of the narrowest part of the ilium, near the insertion of the *psoas parvus*.

Insertion; by flat tendinous fascia into the inner side of the leg below the knee.

2. *Psoas magnus*, ... 47·5

Origin; from the lumbar vertebræ, with one slip from the true pelvis, from the inner margin of the ilium.

Insertion; by a common tendon with, and inside the *M. iliacus*, into the lesser trochanter.

3. *Iliacus*, ... 34·5

Origin and insertion; as usual.

4. *Pectinæus*, ... 28·0

Origin; from the inferior margin of the anterior crest of the pubis.
Insertion; into the femur at lower point of trisection, by a strong round tendon.

5. *Adductor brevis*, ... 7·0

Origin; from the symphysis pubis (middle two inches).
Insertion; by a flat tendon, inside the insertion of the *adductor magnus*.

6. *Adductor magnus*, ... 32·5

Origin; from the arch of the pubis, backwards, nearly as far as the tuberosity of the ischium.
Insertion; into the back of the outer condyle, and halfway up the femur.

7. *Obturator externus*, ... 19·0

Origin; as usual.
Insertion; into the upper half of the line leading from the great trochanter to the posterior trochanter.

8. *Adductor longus*, ... 12·0

Origin; from the arch and symphysis of the pubis, lying under the *M. gracilis*.
Insertion; into the lower half of the *linea aspera* and inner condyle of the femur.

9. *Quadratus femoris*, ... wanting.

10. *Obturator internus*, ... 3·0

Origin; from the ilium above the ischiadic notch, and without any fibres from the rim of the foramen; it is a long slip of muscle (Qu. *Gemellus superior?*)

11. *Gemellus inferior*, ... 2·5

12. *Glutæus maximus* (Fig. 36), ... 208·0

Origin; from the posterior half of the ilio-ischiadic line, and from the sacro-ischiadic ligament.
Insertion; by means of a tendon, 4½ inches in length, into the top of the fibula and fascia of the leg; it gives off two tendinous slips to the greater and posterior trochanters in passing.

13. *Glutæo maximo accessorius* (Fig. 36), ... 13·0

Origin; from the vertebral edge of the ilio-ischium, in front of the origin of the *Glutæus maximus*.
Insertion; by a long tendon into the posterior trochanter.

14. *Gluteus medius* (Fig. 36), ...

Origin; from the whole outer surface of the ilium, on its posterior border by *gl. max.*, and its accessory,

Insertion as usual.

15. *Gluteus minimus*, ...

Origin; from a small surface of the narrowest porti near the ischiadic notch.

Insertion; into the anterior ridge of the great trocha

16. *Tensor vaginæ femoris*, ...

Origin; from the crest of the ilium.

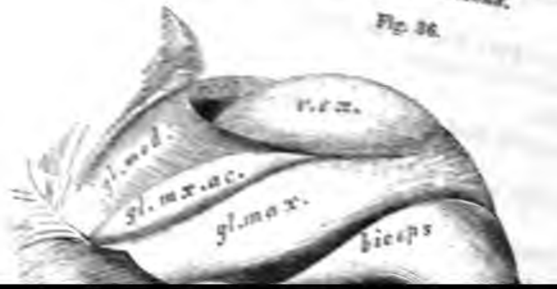
Insertion; into the fascia of the knee, principally on t but partly on the inner side; its insertion on the outer rated from the *gluteus maximus* by a strong fascia.

17. *Biceps femoris* (Fig. 36), ...

Origin; from the tuberosity of the ischium.

Insertion; into the whole length of the outer side of the down as the heel, by fascial attachment; and is intimately b its muscular portion with the *semitendinosus*.

Fig. 36.



Oz. Av.

19. *Semitendinosus* (Fig. 36), ... 64·0

Origin; from the tuberosity of the ischium.

Insertion; by a tendon, one inch broad, into the point of bisection of the tibia.

20. *Gracilis*, ... 45·0

Origin; from the arch of the pubis and two inches of posterior portion of its symphysis.

Insertion; into the head of the tibia, by a tendon, three inches in length.

21. *Rectus femoris* (Fig. 36), ... 54·0

22. *Vastus externus* (Fig. 36), ... 54·5

A strong ligament joins the greater and posterior trochanters, under which the outer head of the *vastus externus* passes.

23. *Vastus internus*, ... 41·5

24. *Crureus*, ... 21·5

25. *Popliteus*, ... 5·5

Origin; by a strong tendon from the outer condyle of the femur; this tendon forms one of the ligaments of the knee joint, and winds round the back of the head of the fibula.

Insertion; into the upper half of the back of the tibia.

26. *Gastrocnemio-soleus*, ... 29·0

Insertion; into the os calcis.

27. *Plantaris* (*flexor perforatus*), ... 3·5

Origin; from the back of the outer condyle, covered by *gastrocnemius*.

Insertion; into the *plantar fascia* covering the os calcis, from which it passes on to the common junction of flexor tendons in the sole of the foot, and ultimately expends its force on the three *perforate* tendons of the toes.

N. B.—This seems to be the *plantaris* and *flexor digitorum brevis* (*perforatus*) combined.

28. *Flexor digitorum* (*perforans*), ... 21·0

Origin; from the whole back of the fibula, and from the lower half of the tibia.

N. B.—This seems to be the *flexor digitorum longus* and *flexor hallucis longus* combined.

29. *Tibialis anticus*, ... 10·0

Origin; from the upper anterior half of the tibia.

Insertion; into the inner edge of the inner tarsal *cuneiform*.

Oz. Av.

30. *Extensor digitorum longus*, ... 19·5

Origin; from the outer condyle of the femur, by a strong tendon.
Insertion; double:—

Oz. Av.

a. Into the inner tarsal (cuneiform), ... 5·5
b. By two tendons inserted into the inner sides of the first phalanges of outer and inner toes, ... 14·0

19·5

31. *Peronæus longus*, ... 1·75

Origin; from the outer condyle of the femur.

Insertion; by a pulley passing under the outer ankle, winding obliquely outside it, and crossing the sole of the foot, to be inserted two-thirds of the way across into the under surface of the middle cuneiform bone.

32. *Peronæus brevis*, ... 3·5

Origin; from the whole outer side of the fibula.
Insertion; into the near end of the first phalanx of the outer toe.

33. *Extensor brevis digiti medii*, ... 9·5

Origin; by a strong tendon from the calcaneum, just below the ankle joint, and by fascia from the whole breadth of the instep.

Insertion; into the near end of the first phalanx of the middle toe.

34. *Interossei digiti externi*, ... 5·0
35. *Interossei digiti medii*, ... 2·0
36. *Interossei digiti interni*, ... 4·0

B.—*Muscles of the Fore Limb.*

Oz. Av.

1. *Trapezius clavicularis* (vel *cervicohumeralis*), ... 35·0

Origin; from the transverse process of the axis.

Insertion; into the head of the humerus, in a transverse line, 2½ inches long, from the great tuberosity.

2. *Trapezius scapularis*, ... 32·0

Origin; from the spines of the dorsal vertebræ.
Insertion; into the end of the spine of the scapula.

3. *Omo-atlanticus* (vel *brachio-atlanticus*), ... 24·0

Origin; from the transverse process of the atlas.

Insertion; into the front of the lower part of the humerus: is a long round muscle.

Oz. Av.

4. *Rhomboideus,* . . . . 8·5

Oz. Av.

a. Externus, vel levator anguli inferioris scapulæ, 7·0
b. Internus, ... 1·5

8·5

5. *Serratus magnus,* . . . . 79·0

Includes the *levator anguli scapulæ superioris.*

6. *Teres major,* . . . . 21·0

7. *Latissimus dorsi,* . . . . 61·0

Has tendon in common with *teres major.*

8. *Tricipiti accessorius,* . . . . 22·0

This muscle takes its origin from the ribs, and forms a costal head of the *triceps,* into the back of which it passes, behind the olecranon process.

9. *Subscapularis,* . . . . 28·0

10. *Pectoralis minor?* . . . . 98·0

Origin; from the sternum and first six ribs.

Insertion; into the pectoral ridge, from the greater to the lesser tuberosity of the humerus.

11. *Pectoralis major?* . . . . 49·5

Origin; from the keel along the anterior half of the sternum, and from the ribs.

Insertion; into the oblique line down the whole inner side of the ulna.

12. *Pectoralis avium? (subclavius?)* . . . . 24·0

Origin; from the first rib and side of the top of sternum.

Insertion; into the outer summit of the greater tuberosity, and by fascia passing over the *supraspinatus,* into the scapulæ—*levator humeri.*

13. *Coraco-brachialis,* . . . . 2·5

Origin; from the coracoid process inside the *biceps.*

Insertion; into the inner and anterior side of the middle of the humerus, by a flat insertion, three inches in length.

14. *Deltoideus scapularis,* . . . . 25·5

Origin; from nearly the whole length of the spine of the scapula.

Insertion; into the outer side of the great tuberosity.

N. B.—The *deltoideus clavicularis* is merged in the *cervico humeralis,* or *trapezius clavicularis* No. (2), which forms a part of the great *delto-trapezius.*

Oz. Av.

15. *Supraspinatus*, ... 83·0

16. *Infraspinatus*, ... 55·0

17. *Biceps humeri*, ... 21·5

This muscle takes origin as usual; but it is remarkable that the tendon passing over the head of the humerus is much stronger than the muscle itself requires. I do not know the reason of this singular circumstance.

Inserted, as usual, into the tubercle of the radius.

18. *Brachiæus externus*, ... 34·5

Origin; arises from the outside, backside, and part of the inside of the head of the humerus, winding outwards round the shaft of the bone, to be inserted in the radius by a flat prolonged tendon, below and to the inside of the tubercle of the radius.

19. *Triceps humeri*, ... 224·0

20. *Flexor carpi radialis?* . . . . 8·75

Origin; from the inner side of the inner condyle of the humerus.

Insertion; by a long tendon passing in a groove at the inner side of the wrist, then plunging deep into the palm, to be finally inserted, below the short flexors, into the bases of the metacarpals of the inner and middle fingers.

21. *Palmaris longus*, ... 6·25

Origin; from the inner and back side of the olecranon.

Insertion; into the common junction of the palmar tendons at the bend of the wrist.

22. *Flexor carpi ulnaris*, ... 4·5

Origin; from the back of the inner condyle and olecranon.

Insertion; into the carpal bone (*pisiforme*), articulating with the ulna.

N. B.—A ligament connects this bone with the sesamoid bone, into which the *extensor carpi ulnaris* is inserted, so as to cause both muscles to *flex* and *abduct* the outer side of the hand.

23. *Flexor digitorum communis*, ... 19·5

The superficial and deep flexors unite in a common tendon at the wrist, from which proceed three perforating and three perforate flexors. At the same point of junction of tendons there are also found—

1. A tendinous ligament from the inner condyle, without any muscular fibres attached;
2. The tendon of a small muscle (24), which seems to be the *flexor pollicis longus*.

24. *Flexor pollicis longus?* . . . . 1·0

Origin; from the radius and ulna, and interosseous septum.

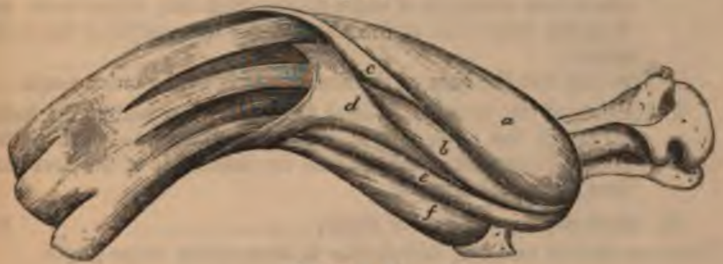
	Oz Av.
25. *Supinator radii longus?*	1·75

Origin; from the fascial covering of the outer condyle.
Insertion; into the tendon of (26) at the wrist.

N. B.—This muscle acts chiefly as a tensor fasciæ, but is, no doubt, the representative of the *sup. rad. longus*.

26. *Extensor carpi radialis* (Fig. 37, *a*), ... 37·5

Fig 37.



Left Fore Arm.

Origin; from the outer condyle.
Insertion; into the near end of the middle finger.

N. B.—This muscle receives at the bend of the wrist the tendon of the *supinator longus*.

27. *Extensor digitorum longus* (Fig. 37, *b*), ... 13·5

Inserted into the near end of the first phalanx of the middle finger.

28. *Extensor minimi digiti* (Fig. 37, *e*), ... 6·0

Origin; from the outer condyle, and from the tendinous expansion of the interosseous septum from the outer condyle to the wrist.

Insertion; into the outer side of the first phalanx of the outer finger, with a tendinous slip to the metacarpal of the middle finger.

29. *Extensor carpi ulnaris?* . . . . 27·5

Origin; from the outer condyle.
Insertion; into the sesamoid bone outside the base of the metacarpal of the outer finger.

N. B.—I am almost certain that this muscle is the *extensor ulnaris*, although, owing to the arrangement described in (22), it acts as a *flexor*. The combined actions of the ulnar flexor and extensor would be to abduct the little finger—an action which would be of great use to the Rhinoceros when running on soft ground.

30. *Extensor ossis metacarpi pollicis* (Fig. 37, *c*), ... 4·5

Origin; from the anterior half of the radius and ulna, and from the interosseous septum.

Insertion; its tendon crosses the back of the wrist, binding down the tendons of the radial extensor, and is inserted into the outer side of the near end of the metacarpal of the inner finger.

The following muscles are found in the palm :—	Oz. Av.
31. *Short flexors of the outer finger,*	5·5

	Oz. Av.
a, ...	2·5
b, ...	3·0
	5·5

a. Origin; from the ligament already described (22) joining the pisiform and sesamoid of outer finger, from one carpal bone, and from the inner side of the shaft of the metacarpal of the outer finger.

Inserted into the base of the first phalanx of the outer finger.

b. Consists of two muscles, arising from the inner half of the metacarpal of the outer finger, and from the carpal bone of the middle finger, and inserted into the inner side of the first phalanx of the outer finger.

32. *Short flexors of the inner finger,* . . . . 5·0

These are two in number, and similar to those of the outer finger.

33. *Short flexors of the middle finger,* . . . . 2·0

These are two in number.

The Rev. Samuel Haughton, M.D., Fellow of Trinity College, Dublin, read the following paper:—

Notes on Animal Mechanics.

XVII.—On the Comparative Myology of certain Birds.

In order to compare the muscles of different classes of birds, I dissected two Tiercel Peregrines, a Falcon Peregrine, a Cara Cara Hawk, a Demoiselle Crane, and a Canadian Goose.

The Cara Cara Hawk (*Polybarus*, or *Falco Braziliensis*) presents a most striking resemblance to the Peregrine Hawk, and, judging from his muscular anatomy, must be regarded as a Hawk, and not a Vulture.

A.—*Muscles of the Leg.*

	Tiercel.	Falcon.	Cara.	Crane.	Goose.
	Oz.	Oz.	Oz.	Oz.	Oz.
1. *Sartorius*,[a] . . .	0·05	0·08	0·05	0·11	0·57
2. *Adductores*,[b] . .	0·04	0·05	0·09	0·18	0·40

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[a] The *Sartorius* takes its origin from the anterior curved edge of the ilium, and is inserted by a broad tendon into the side of the knee joint and tibia.

[b] In the Peregrine and Cara there was only one *adductor*; in the Crane and Goose there were two, viz.—

	Crane.	Goose.
	Oz.	Oz.
Adductor magnus, . . .	0·12	0·23
Adductor longus, . . .	0·06	0·17
	0·18	0·40

	Tiercel. Oz.	Falcon. Oz.	Cara. Oz.	Crane. Oz.	Goose. Oz.
3. *Obturator externus*,	0·03	0·03	0·04	0·04	0·12
4. *Obtur. internus*, &c.,	0·02	0·02	0·03	0·02	—
5. *Gubernator caudæ*,[c]	0·02	0·02	0·02	—	0·20
6. *Glutæus maximus*,[d]	0·01	0·01	0·01	0·09	1·07
7. *Glutæus medius*,[e]	0·04	0·04	0·10	0·17	0·78
8. *Glutæus minimus et Gl. quartus*,[f]	0·04	0·03	0·03	0·04	0·73
9. *Tensor vaginæ femoris*,[g]	0·07	0·03	0·07	—	0·52
10. *Biceps femoris*,[h]	0·08	0·08	0·10	0·16	0·72
11. *Semimembranosus*,[i]	0·02	0·02	0,05	0·09	0·17
12. *Semitendinosus*,[i]	0·03	0·03	0·05	0·07	0·07
13. *Gracilis*,[k]	0·04	0·03	0·05	—	0·11
14. *Rectus femoris*,[l]	—	—	—	—	—
15. *Vastus externus et Vastus internus*,	0·13	0·11	0·13 0·03	0·30	0·85

		Crane. Oz.	Cara. Oz.
16. *Gastrocnemido-solæus*,		0·31	0·18
α. Outer head,	0·09		(Four heads).
β. Middle head,	0·06		
γ. Inner head,	0·16		
	0 31		
17. *Plantaris*,		0·01	—
18. *Tibialis anticus*,		—	0·14

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[c] This muscle is quite distinct from the *agitator caudæ*, and lies in a plane below it. In the Falcon and Cara it takes origin from the transverse process of the large terminal caudal vertebra (*ploughshare*), and is inserted into the second fifth from the top of the linea aspera by means of a flat tendon; in the Goose it is inserted into the middle of the lower part of the *glutæus medius*; and in the Duck into the outer head of the fibula.

[d] The *glutæus maximus* in the Falcon and Cara takes its origin from the edge of the ilium, in a plane below that of the *ten. vag. fem.*, for one-fourth of an inch in front of the acetabulum, and has the usual insertion; in the Crane its origin is from the post-acetabular edge of the ilium, and it is inserted by a broad tendon into the middle of the *vastus externus* and fascia of the outer side of the thigh; and in the Goose it is inserted into the fascia of the inner side of the knee.

[e] The *gl. medius* has the usual insertion in the Falcon, Cara, and Crane; but in the Goose and Duck it is inserted into the middle of the *linea aspera*.

[f] Quite separate in the Crane; *gl. min.* = 0·01, *gl. quartus* = 0·03.

[g] This small muscle, in conjunction with the *sartorius*, in most birds serves instead of a *rectus femoris*.

[h] The *biceps femoris* in the Falcon, Cara, and Crane, passes through the usual tendinous pulley at the outer side of the lower end of the femur, and outer head of the *gastrocnemius*; in the Goose and Duck it is inserted into the tibia, at the inner side of the knee.

[i] These muscles in the Falcon and Cara are inserted by flat tendons into the tibia; and in the Crane they are also inserted into the upper tendinous portion of the inner head of the *gastrocnemius*.

[k] This muscle, in the Falcon and Cara, takes origin from three-fourths of the length of the pubis behind the acetabular prominence of that bone.

[l] There is a *rectus femoris* in the Falcon and Cara, arising from the ilium, in front of the acetabular prominence of the pubis; it is a fine delicate muscle, weighing 0·01 oz. in the Cara, and its tendon passes obliquely across the front of the knee joint from within outwards, and, winding down into the calf, forms one head of the *first perforate flexor of the second toe*, the muscular portion of which is connected by muscular slips with the *first perforate flexors* of the third and fourth toes, and with the *second perforate flexor* of the third toe. The weight of the *first perforate flexor* of the second or index toe in the Cara, was 0·02.

This muscle is thus described by Cuvier:—

"Il y a dans le lieu qu'occupe le pectineux des quadrupedes, un petit muscle grêle, qui se prolonge jusqu'au genou. Son tendon passe obliquement pardessus, et se glisse derriere la jambe pour s'unir au fléchisseur perforé du second et du cinquième doigt."[*]

Professor Owen[†] regards this muscle as the *gracilis*; while he considers as *rectus femoris* the muscle already described as *tensor vaginæ femoris*.

[*] "Lecons d'Anatomie comparée," tom. i., p. 359.

[†] "Cyclopædia of Anatomy," vol. i., p. 296.

B.—*Muscles of the Wing.*

	Tiercel. Oz.	Falcon. Oz.	Cara. Oz.	Crane. Oz.
1. *Serratus magnus*,	0·04	0·06	0·05	—
2. *Rhomboideus*,	0·02	0·03	0·07	—
3. *Teres major*,[m]	0·02	0·02	0·02	—
4. *Latissimus dorsi*,	0·03	0·03	0·04	—
5. *Subscapularis*,	0·04	0·04	0·04	—
6. *Pectoralis minor*,	0·05	0·05	0·04	0·06
7. *Pectoralis major*,[n]	0·73	0·76	1·03	2·06
8. *Pectoralis secundus avium*,	0·08	0·11	0·10	0·37
9. Wingfolder (*extensor plicæ alaris*),[o]	0·03	0·04	0·04	—
10. *Coracobrachialis*,	0·03	0·03	0·02	—
11. *Deltoideus internus* (*clavicularis*),[p]	0·03	0·02	0·02	—
12. *Deltoideus externus* (*scapularis*),[q]	0·09	0·08	0·12	—
13. *Supra et infra spinatus*,[r]	0·09	0·07	0·10	—
14. *Biceps humeri*,	0·05	0·04	0·06	—
15. *Triceps humeri*,	0·11	0·14	0·15	—

The Rev. SAMUEL HAUGHTON, M.D., Fellow of Trinity College, Dublin, read the following paper:—

NOTES ON ANIMAL MECHANICS.

XVIII.—ON THE COMPARATIVE MYOLOGY OF CERTAIN RUMINANTS.

IN the following comparisons of the muscles of Ruminants I have made the Indian Goat the standard; the other animals examined being the Virginian Deer, the Nylghau, and Napu Deer of Java.

A.—*Muscles of the Hind Limb.*

	Goat. Oz.	Deer. Oz.	Napu. Oz.
1. *Sartorius*,[s]	0·11	1·25	0·13
2. *Tensor vag. femoris*,	0·42	4·25	
3. *Psoas magnus*,	0·97	7·50	0·37
4. *Iliacus*,	0·26	2·50	0·05
[*Psoas parvus*],	0·15	1·75	0·04
5. *Pectinæus*,	—	2·25	0·03

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[m] The *teres major* arises from the spinous processes of the lower dorsal vertebræ, and crosses the lower extremity of the scapula, to be inserted by a flat tendon into its usual place in the humerus.

[n] A slip from the upper edge of this muscle joins the wingfolder (*extensor plicæ alaris* Carus).

[o] This muscle takes its origin from the acromion, and is inserted into the wrist, acting directly as a folder of the wing.

[p] Arises from the tip of the acromion, and is inserted into the top of the humerus, inside the pectoral ridge.

[q] Origin, from the portion of the scapula adjoining the acromion; insertion into the outer side of the pectoral ridge of the humeras; rotates the arm powerfully outwards.

[r] Arise from the lower two-thirds of the outer side of the scapula.

[s] The *sartorius* in the Goat has a double origin—

a. From the anterior edge of the pubis, close to the acetabulum.
b. From the anterior superior crest of the illum, by fascia.

	GOAT. Oz.	DEER. Oz.	NAPU. Oz.
6. *Adductor brevis*,	0·41	—	0·05
7. *Adductor longus*,	1·28	—	—
8. *Adductor magnus*, [b]	1·19	23·50	0·66
9. *Semimembranosus*,			
10. *Semitendinosus*,	0·43	9·25	0·13
11. *Obturator externus*,	0·48	—	—
12. *Quadratus femoris*,	0·12	—	0·03
13. *Obturator internus*, &c.,[c]	0·17	—	—
14. *Glutæus maximus*, [d]	1·86	36·50	0·59
15. *Biceps femoris*,			
16. *Glutæus medius*,	1·11	10·00	0·19
17. *Glutæus minimus*,[e]	0·50	1·75	0·06
18. *Glutæus quartus* (*iliocap.*),[e]	0·29	1·00	0·04
19. *Gracilis*,[f]	0·40	4·50	0·08
20. *Rectus femoris*,	1·15	10·50	—
21. *Vastus externus* (a),	0·85	11·75	—
22. *Vastus externus* (b),	0·28	—	—
23. *Vastus internus* (a),	0·36	4·25	—
24. *Vastus internus* (b),	0·29	—	—
25. *Cruræus*, &c.,	—	2·75	—

Leg of Goat.

	Oz.		Oz.
26. *Gastrocnemido-solæus*,	0·92	31. *Tibialis anticus*,[i]	0·22
27. *Plantaris*,[g]	0·06	32. *Extensor digitorum communis*,[i]	0·09
28. *Poplitæus*,	0·15	33. *Peronæus longus*,	0·04
29. *Flexor digitorum longus*,	0·25	34. *Peronæus brevis*,	0·08
30. *Flexor hallucis longus*,[h]	0·04		

B.—*Muscles of the Fore Limb in the Goat.*

	Oz. Av.
1. *Trapezius scapularis*,	0·35

Origin; from the cervical vertebræ (4 – 7); and from the dorsal (1 – 4).

Insertion; into the spine of the scapula; separable with difficulty from the next.

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[b] These muscles are combined in their muscular portion into one fleshy mass in the Goat, Deer, Nylghau, and little Napu; but retain their characteristic insertions into the whole length of the back of the femur, and into the top of the tibia and fascia of knee joint.

[c] The anterior border of the *gemelli* joins the posterior border of the *iliocapsularis*.

[d] The *gl. max.* and *biceps fem.* form one muscle, having the double origin. In the Goat the insertion is into the fascia of the thigh below the trochanter, and one-third down the outer side of the leg; in the Deer and Nylghau the portion with glutæal origin has bicipital insertion, and the portion with bicipital origin is inserted into the fascia of the inner side of the knee; in the Napu the origin of these muscles is covered by the sacral fascia, which, with the lumbar, is converted partially into a bony covering; the insertion is into the fascia of the knee joint, and down the whole outer side of the leg as far as the os calcis.

[e] The *gl. min.* and *gl. quartus* form one muscle in the Nylghau.

[f] Inserted with the *semitendinosus* into the upper third of the leg.

[g] The *plantaris* is represented by a muscular slip from the back of the top of fibula.

[h] This little muscle takes its origin from the tibia, just below the *poplitæus*, and is inserted at half an inch below the heel into the tendon of the common flexor.

[i] The *tibialis anticus* arises from the anterior curved surface of the tibia, and by a round tendon, common to it with the *extensor digitorum longus*, from the anterior surface of the outer condyle, inside the knee joint.

Oz. Av.

2. *Trapezius* (*clavicularis*), (*Humeromastoideus*), ... 0·77

Origin; from the mastoid process and fascia covering the second vertebra.

Insertion; into the fascia of No. 1, covering the anterior portion of the spine of the scapula, passing downwards (as external deltoid) into the fascia covering the *biceps*, and finally inserted by common tendon with biceps into the forearm.

3. *Rhomboideus*, ... 0·31

Including an accessory slip from the fourth cervical.

4. *Serratus magnus*, ... 2·73

5. *Teres major*, ... 0·23
6. *Latissimus dorsi*, ... 0·43

There is also a *latissimus dorsi superficialis*, part of the *panniculus carnosus*, which extends from the border of the true *lat. dorsi et pectoralis major*, partly covering both these muscles, and is inserted into the fascia of the back of the humerus, both on the inner and on the outer side, and into the elbow joint.

7. *Subscapularis*, ... 0·59
8. *Pectoralis minor*, ... 0·82
9. *Pectoralis major*, ... 0·51

Inserted into the fascia binding down the *biceps*, and into the near end of the ulna.

10. *Coracobrachialis*, ... 0·07

11. *Deltoideus externus*, ... 0·13

Lies under the *humeromastoid*.

12. *Supraspinatus*, ... 1·72
13. *Infraspinatus*, ... 1·34

14. *Teres minor*, ... 0·09

Arises from the middle of the lower border of the scapula, and is inserted into the fascia covering the outer head of the *triceps*.

15. *Infraspinatus secundus*, ... 0·12

This muscle is analogous to the *glutæus quintus* of the hind limb, found in the Kangaroo.

Origin; from the anterior third of the lower border of the scapula.

Insertion; into the greater tuberosity of the humerus, below the tendon of the *infraspinatus*, to which it seems related, as the *iliocapsularis* (*gl. quartus*) is to the *gl. minimus*.

Oz. Av.

16. *Biceps humeri*, ... 0·32

Inserted partly into the front of the bone of the forearm, to which it gives a direct lift, and partly by a tendon winding in a groove round it, being inserted into its inner and under surface.

17. *Brachiæus* (*externus*), ... 0·26

Its tendon crosses the tendon of *biceps*, and is inserted on the inner and under side of the bone of the forearm, below the insertion of the *biceps*.

18. *Triceps*, ... 1·98

Has a fourth head, from *latissimus dorsi*.

19. *Anconæus*, ... 0·16

20. *Flexor carpi ulnaris*, ... 0·11

Inserted into the near end of cannon bone by a common tendon with *extensor carpi ulnaris*.

21. *Flexor carpi radialis*, ... 0·07

Origin; from the inner condyle.

Inserted into the near and inner end of the cannon bone by a tendon passing through a groove in the wrist, inside that of the *flexor profundus*.

22. *Flexor digitorum sublimis*, ... 0·22

23. *Flexor digitorum profundus*, ... 0·48

24. *Supinator radii longus*, ... 0·32

Inserted into the back of near end of cannon bone.

25. *Extensor carpi radialis*, ... 0·05

Distributed to the back of ungual phalanx of the outer toe, and by fascia to the inner toe.

26. *Extensor digitorum communis*, ... 0·09

Distributed equally to both toes.

27. *Extensor carpi ulnaris*, ... 0·33

This important muscle, as in the Rhinoceros, actually flexes the wrist, though it represents the ulnar extensor; it is inserted by two tendons (of which one is common to the *flexor carpi ulnaris*) into the near end and inner side of the cannon bone. It takes its origin by a round tendon from the front of the outer condyle, inside the elbow joint, like the *tibialis anticus* and *extensor digitorum pedis*.

28. *Extensor ossis metacarpi pollicis*, ... 0·03

Arises from the ulna and interosseous membrane; and is inserted principally into the back of the phalanx of the inner toe.

The following donations were then presented:—

A collection of sixteen Original Views of the principal Buildings in Dublin, by the late George Petrie, LL. D.: presented by the Marquis of Kildare.

A perfect and beautifully formed Celt, of micaceous grit, found in a bog near Hacketstown, county of Carlow: presented by the Hon. and Ven. Archdeacon Stopford.

The Secretary read a letter from C. Darwin, Esq., returning thanks for his election as Honorary Member of the Academy.

MONDAY, MAY 14, 1866.

Sir William R. W. Wilde, M.D., Vice-President, in the Chair.

John Barrington, Esq., D. L.; John Casey, Esq.; and William Frazer, Esq., were elected Members of the Royal Irish Academy.

The Rev. J. H. Jellett read a paper

On a Fluid possessing Opposite Rotatory Powers for Rays at Opposite Ends of the Spectrum.

He commenced by alluding to the construction of an instrument which he had exhibited and described to the Academy some time ago.[*] The purpose of this instrument is to measure the rotatory power of a transparent fluid, not directly, but by the method of *compensation*. For this purpose the ray of polarized light, before[†] its passage through the fluid under examination, is transmitted through a fluid of an opposite rotatory power; and the construction of the instrument provides a method of varying and measuring with exactness the length of the column of this latter fluid through which the ray passes. The fluids used for this purpose were, in general, the two well-known species of oil of turpentine—namely, that which is obtained from the *Pinus maritima* of the South of France, and that which is obtained from the *Pinus Australis* of North Carolina. The former of these, being a left-handed substance, is used in the examination of fluids which, like the solution of cane sugar, are right-handed; and the latter, being right-handed, for those substances which, like the solution of quinine, and the great majority of fluids possessing the rotatory power,[‡] are left-handed.

A means is thus obtained of comparing the rotatory powers of all fluids for which the rotation is in the same direction; but, in order to compare those whose rotatory powers are opposite, it became necessary, in the first place, to ascertain the relative rotatory powers of the two standard fluids. This was, of course, to be done by compensating with one of these fluids the effect produced by the other. When this is done, it is plain that the length of the columns of the two fluids through which the light passes will be inversely proportional to their rotatory powers. The author did not anticipate any difficulty in effecting this compensation; for, inasmuch as the two species of oil of turpentine, chemically identical in their composition, differ very slightly in their refractive and dispersive powers, the law assumed by Biot would lead us to expect that the rotations produced in the planes of polarization of any two homogeneous rays should be in nearly the same ratio in each of these fluids. If this were true, the ratio of the lengths of equivalent columns of these fluids should be nearly the same for all the rays of which white light is composed; and therefore, when these columns are so proportioned that the *intensities* of the light in the two images* are the same, the *tints* will also be the same, so that there should be no difficulty in making the experiment.

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[*] "Proceedings," vol. viii., p. 279.

[†] The order of transmission is indifferent, but the construction of the instrument requires that the light should pass *first* through the compensating fluid.

[‡] So far at least as the author has examined them.

The actual result, however, was wholly different from that which the law of Biot had thus led the author to anticipate. So far from giving a tolerably perfect compensation, the two species of oil of turpentine compensate each other more *im*perfectly than any two substances which the author has examined—in fact, it is scarcely possible to make the experiment at all. When the lengths of the columns of fluid are so adjusted that the intensity of the light shall be the same in the two images,† the tints are found to be wholly different. The left-hand image shows a very brilliant sky-blue, and the right-hand image an equally brilliant rose colour; the beauty of these colours is very remarkable. There is, therefore, plainly a deficiency of red light in the left-hand image, and a deficiency of blue light in the right-hand image.

In seeking to interpret this appearance, it is to be remarked that when the light passes through a single fluid whose rotatory power is not very great, left-handed rotation is indicated by the darkening of the left-hand image, and right-handed rotation by a similar effect produced in the right-hand image. Assuming, then, that, in the compound effect produced by transmission through the two columns, the rotation is compensated, or in other words reduced to zero for the mean ray, it is plain that this effect will be left-handed rotation for the red ray, and right-handed rotation for the ray at the other extremity of the spectrum. It is evident, therefore, that the right-handed or Carolina turpentine rotates the plane of polarization of the red ray *less*, and that of the blue ray more than the left-handed or Bourdeaux turpentine. The Carolina turpentine is, therefore, more *dispersive* of the planes of polarization than the other.

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* "Proceedings," vol. vii., p. 349.

† So far at least as this can be effected; but the truth is, that it is almost impossible to compare with any tolerable degree of accuracy the intensities of light whose colours are so different. Even readings taken by the same observer will not agree with each other, and the *personal equation* will obviously be very large.

In reasoning on this experiment it occurred to the author that a similar effect ought to be produced if the ray of polarized light, instead of passing successively through two columns of French and American oil of turpentine, were transmitted through a single column, composed of a mixture of these two fluids. As they are identical in chemical composition, it did not seem probable that any chemical action could take place; and therefore, in accordance with the principle found to hold good for mixtures in general, the effect of two columns of fluid, when mixed together, ought to be the sum of the effects which they produce separately. If, therefore, the lengths of the two columns be such that they compensate each other for the mean ray, the fluid produced by mixing them together ought to exercise a left-handed rotation on the plane of polarization of the red ray, and an opposite effect upon that of the blue ray.

This anticipation was fully realized by the actual experiment. Some difficulty was found in ascertaining experimentally the exact proportion in which the fluids should be mixed together. The source of this difficulty is, as has been before stated, the impossibility of comparing with exactness the intensities of lights whose colours are different, and therefore of ascertaining the ratio of the lengths of two columns which compensate each other for the mean ray; and a small deviation from the true proportion will render the rotation produced by the mixture either wholly right-handed, or wholly left-handed.

The best method of ascertaining this proportion is to measure successively the actual rotations produced by each kind of oil of turpentine in the planes of polarization of the red and blue rays. Let F_r be the rotation produced in the plane of polarization of the red ray by the column of Bourdeaux turpentine; F_b that produced in the plane of polarization of the blue ray, and A_r, A_b, the corresponding rotations produced by American turpentine; then, if m be the quantity of French turpentine in the mixture, and n the quantity of American turpentine, the mixture will be right-handed for the red ray (and therefore *à fortiori* for all the rest), if

$$\frac{n}{m} = \text{or} > \frac{F_r}{A_r};$$

on the other hand the mixture will be left-handed for the blue ray, and therefore for all the less refrangible rays, if

$$\frac{n}{m} = \text{or} < \frac{F_b}{A_b};$$

and if the value of $\frac{n}{m}$ be intermediate to these two values, the fluid is possessed of double rotation. The phenomenon is rendered most striking by givin[illegible] two fluids in the mixture such a proportion that the left-handed and right-handed rotations may be equal to each other. If this be so, we shall have

$$mF_r - nA_r = nA_b - mF_b;$$

whence

$$\frac{m}{n} = \frac{A_b + A_r}{F_b + F_r}.$$

In order to measure exactly the quantities A_r, A_b, F_b, F_b, it was necessary in the first place to obtain rays as nearly homogeneous as possible. This was easily effected in the case of the red ray by transmitting a solar beam successively through blue and red glasses—this combination, as is well known, only permitting the extreme red ray to pass. It is not possible to obtain so homogeneous a ray at the other extremity of the spectrum; but the condition is very approximately fulfilled by transmitting the ray through a solution of sulphate of copper supersaturated with ammonia. The light transmitted by a sufficient thickness of this fluid, though not homogeneous, is almost entirely composed of rays situated at the violet end of the spectrum, the red, orange, and yellow rays being nearly extinguished.

The following were the values obtained for a column of each fluid whose length was four inches:—

$$A_r = 6^\circ\ 58',$$
$$A_b = 33^\circ\ 36',$$
$$F_r = 19^\circ\ 45',$$
$$F_b = 61^\circ\ 23',$$

Hence we find

$$\frac{m}{n} = \cdot 499.$$

When a mixture made nearly in this proportion was traversed successively by solar light which had passed through a combination of red and blue glass, and by light which had passed through a sufficient thickness of the ammoniacal solution of sulphate of copper, the effect was very striking. With blue light, the *left* side of the spectrum was almost quite black, while the right side was a bright violet-blue; with red light, the *right* side of the spectrum is nearly black, and the left side a bright red. This appearance indicates that the fluid, through which the light has been transmitted, is left-handed for the red ray, and right-handed for the blue and violet. The actual rotations are—

For red light, ...	$-\ 1^\circ\ 45'$,
For blue light, ...	$+\ 1^\circ\ 56'$;

the mixture containing 67 parts of American turpentine, and 33 of French turpentine. The ratio in which the two species of oil of turpentine should be mixed, in order to produce this phenomenon, must be understood to apply only to the particular specimens examined; for the rotatory power of oil of turpentine will be found to vary with the specimen used, and also to some extent with the number of distillations to which it has been subjected. To insure success, this ratio must be determined by actual measurement for the specimens of oil of turpentine examined. A certain amount of difficulty attends this measurement, arising from the impossibility of obtaining a homogeneous blue or violet ray of sufficient intensity for the purpose of the experiment. Even when transmitted through a strong solution of sulphate of copper supersaturated with ammonia, the beam will still contain a considerable mixture of rays of different refrangibilities. The rotations A_b, F_b, cannot therefore be measured with perfect accuracy. It is possible, also, that, if the specimens of turpentine be not very pure, there may be some chemical action between the two fluids which will cause the rotation to vary. There may thus be a certain amount of discrepancy between the observed and calculated results in the case of the mixture. Thus in the present case the calculated rotations are—

For red light, ... $-1° 51'$,
For blue light, ... $+2° 6'$.

Sir W. R. W. WILDE read the following unpublished Letter, written by Lord Meath, July 14, 1690, respecting the Battle of the Boyne, and addressed to an ancestor of Sir George Hodson, Bart., of Hollybrook, Bray, who had kindly permitted him to submit it to the Academy:—

"*Dublin, Tho^s Court, July y^e 5^th* (90).

"MADAM,

"Yesterday morning I entered this Tonn^e; after our army & King James had a smart battle for 4 or 5 hou^rs on this side ye Boyn^e boath our whole armies being verey warmly engaged; it hapsoone passe it which gave y^{em} time to run for it and y^e night drawing neere wee did not persue till next morning ; and then it was too late; but well enough; for y^e fled to Dublin and made short stay there ; for King James, Terconnell Ec^t flew through the county of Wickloe in order as I suppose to take shipping at the y^e first port where they can find vessells to transport them ; we killed beside prisoners betweene 6 & 7 thousand, most of there best officers lay ded and gasping upon y^e ground; wee lost Duke Shonberg killed in y^e neck with a muskett ball & somme few officers & soldiers inconsiderable for sutch an engagement; the enemy is so disperced and threw away their armes & run westward y^t there is no danger of there ever Ralling againe, so y^t you may be pleased with the event of a few howers fighting which brings you all home to y^r safe interests & propertys, which I desier may bee for my owne sake as well as yours as soone as you can ; my servise to y^e family of Hobs & Nobs; and y^e Salley stakes are once againe freely at y^r servise, who am,

"Madam
"Y^{re} one hum^{ble} Servant
"MEATH.

"Pray let Matt Anderson & all our friends partake of this thuth we tooke $Lieut^t$ Gen^{ll} Hamilton prisoner who I believe will soone be executed. I am sent for to y^e Campe neere Glasseneivn and can add no more particulars att present."

The thanks of the Academy were returned to Sir George Hodson, Bart., for his permission to exhibit and publish the abovementioned letter.

J. Kells Ingram, LL. D., read a paper, by the Rev. James Byrne, "On the Science of Language."

The Secretary of the Academy informed the meeting that Sir Richard O'Donnell, Bart., was in waiting, and desired that the Caah of Columbkille should be now delivered to him on his personal demand.

It was moved, seconded, and—

RESOLVED,—That Sir Richard O'Donnell be requested to present himself.

Sir Richard O'Donnell then entered the meeting, and signified his wish that the Caah should be forthwith returned to him, agreeably to the conditions upon which he had deposited this reliquary, and its custody had been accepted by the Academy.

The Caah was thereupon produced, and returned by the Chairman into the hands of Sir Richard O'Donnell.

It was then moved, seconded, and—

RESOLVED,—That the hearty thanks of the Academy are due, and are hereby offered to Sir Richard O'Donnell, Bart., for his kindness and consideration in having for so many years allowed this venerable and historic reliquary to remain in their Museum.

Sir Richard O'Donnell then came forward, and placed the Caah in the hands of the Chairman, stating that it was his pleasure to recommit it to the keeping of the Academy as heretofore.

It was moved, seconded, and—

Resolved,—That the fresh thanks of the Academy are due, and are hereby returned to Sir Richard O'Donnell for the renewal of his kindness in depositing the Caah in the Academy's Museum; and that a formal acknowledgment be made to him of the trust.

The following acknowledgment was then ordered:—

"Sir Richard O'Donnell, Bart., has this day deposited in the Museum of the Royal Irish Academy that ancient Irish reliquary, and its contained manuscript, called 'The Caah of Columbkille,' with the understanding that the Academy will take the same care of the said reliquary and its manuscript that they do of the best article in their Museum; and that the Academy will at any time return the said reliquary and its manuscript to the said Sir Richard O'Donnell on his demand, and without any delay, charge, or hindrance whatever.

"And this deposit on the conditions named was approved and accepted by the Academy, at a General Meeting, held in their house, on the same 14th day of May, 1866."

And it was ordered that this acknowledgment, signed by the Chairman, Treasurer, and Secretary, be delivered to the depositor.

The Academy then adjourned.

MONDAY, MAY 28, 1866.

William H. Hardinge, Esq., in the Chair.

Mr. Denis Crofton read the following paper:—

On Vestiges of Ancient Human Habitation in Poole's Cavern, Derbyshire.

Poole's Cavern is an enormous natural excavation in the Carboniferous Limestone of Derbyshire, running for several hundred yards under a hill, about half a mile from Buxton. It is said to derive its appellation from an outlaw named Poole, who is traditionally reported to have made it his place of refuge in the reign of Henry VI. The entrance is very small, and for some distance a man of ordinary height must go into it in a stooping posture. The cave then enlarges, and expands into a capacious passage, with numerous stalactites depending from the roof. It bears marks of having been subjected to the action of water at some former period, there being for a considerable part of the length, on top of the limestone floor, a layer of gravel, about three or four feet deep, covered over by one of brown clay, having a somewhat greater thickness. At the distance of perhaps thirty or forty yards from the mouth of the cavern the widening of the passage suddenly increases or the right hand from the entrance, and leaves a sort of semicircular recess, in which were exhumed the remains upon which I found the opinion that the cave must originally have been the dwelling place of an ancient race of men. These relics were found under the following circumstances:—

In the month of August last, the proprietor, having determined upon making explorations for the purpose of finding out what might be hidden from superficial view, set men to break up the surface, at the distance of a few feet from the side of the cavern, in the before-mentioned recess. As this operation was at the top of both the gravel and clay, it was at the height of some seven or eight feet above the natural floor of the cave. Nearly at the surface, and only slightly covered over, the workmen came upon a layer of stalagmite, of varying thickness, but averaging about three quarters of an inch. After this had been broken through, there came a layer of the brown clay, about ten inches or a foot deep. Below this was another layer of stalagmite, thinner than the upper one, and averaging perhaps an eighth to half an inch thick. When this in its turn had been broken up, there came again about ten inches or a foot more of the brown clay, and then a quantity of bones compacted within a small space, and mingled with fragments of broken pottery, and charcoal, but without flint implements. I was not myself present during the excavation, but upon hearing of it went into the cavern, and made a personal examination of the place, when I found no reason to doubt of the facts having been as described. I also disinterred *in situ*, with my own hands, some pieces of bone which had escaped the first explorers, and brought away some of the charcoal. I further procured a selection of the first found bones, and pieces of pottery. All of these, as well as specimens of the two overlying layers of stalagmite, you may now see before you. One of the pieces of pottery discovered had a sort of rhombic ornamentation figured on what had been the outside of the vessel. The bones are all of animals such as would be used for human food, and there are none human, of carnivora, or extinct species; they comprise remains of the cow, goat, and pig tribes; I am not yet, at least, aware of the existence of any other. There is not, so far as I know, a trace of any of them having been split up for the purpose of extracting the marrow. Upon one bone—an astragalus—an adherent layer of stalagmite has formed.

It is a matter of importance to find out what evidence the organic remains give upon the subject of their own antiquity, and whether this be in any degree confirmatory of what might be surmised from the circumstances under which they were found. The outsides of the bones are to a certain extent decayed and discoloured; and some are light, whilst others are comparatively heavy, which might lead to a suspicion that the latter had been infiltrated with some weighty substance. There are but two such at all likely to cause the phenomenon in question under the circumstances; namely, iron, and carbonate of lime. Accordingly, some portions of the bones which appeared to be heavy have been boiled in hydrochloric acid, and treated with ferrocyanide of potassium, as a test for the existence of the former; and these in the reaction yielded a distinctly blue colour, thus showing evident traces of iron. A fresh beef bone subjected to the same process, for the purpose of comparison, only gave an extremely light tinge of blue. It was thus clear that the cavern bones contained more iron than one perfectly recent does. The question then arose as to whether the infiltration were only superficial, or permeating the substance. This was solved by sawing some of the heavier bones across. During the operation they gave out a strong organic smell; and the sections showed plainly that a large amount of the original organic matter was retained, whilst any decay of gelatine had been chiefly from the outsides, more spongy parts, and fractured surfaces. This also proved that the bones had remained unsaturated with carbonate of lime, or other foreign mineral matter. We must therefore conclude that the iron impregnation was only superficial, derived from the enveloping ferruginous clay, and that the difference in comparative weight must be referred mainly to the greater or less loss of gelatine. Upon the whole, these bones must rather be referred to the class "recent," than that of "subfossil."

The existence of the charcoal and pottery along with the remains leads us to the conclusion that the place in which they were found was used for cooking by the ancient Troglodytes—that the charcoal survived from their fires, and the pottery from their rude culinary utensils. Upon taking a general view of the facts, I am inclined to consider the deposit in the light of what the Danish antiquaries have designated as a "Kjökkenmödding," or "Kitchen dung" heap.

As to the antiquity of the bones it is very hard to give a conjecture; and opinions on these matters, where there is little proof, should always be formed with great caution, and put forward with diffidence. There is, however, one thing which may possibly throw some light on this point, as a matter of circumstantial evidence, and it is the following:— That about four years ago a fibula, and two coins of the reign of Trajan, were found at the opposite side of the cavern, a little further on in it than the bone deposit, at the height of about four inches above the gravel, and in the clay. These I have seen, and have no reason to doubt their genuineness. But there is no evidence as to when or how they got to the place in which they were discovered; and, as there was no stalagmite overlying them, there is nothing determinative of at least a certain degree of antiquity for the time of their embedding. It is right, however, to mention this circumstance, from its possible bearing on my subject. If we allow to it some weight, and combine it with the comparatively recent character of the bones, I think that a period about that of the Roman dominion over Britain may be fairly accepted, provisionally at least, as that of the time of the deposit. This takes it unquestionably out of the domain of geology, strictly speaking, but relegates it to that of archæology.

It is an interesting fact to find that one of the great Derbyshire caverns, like several others which have recently come to light both in

England and on the Continent was anciently appropriated as a place of human habitation.

The following donations were presented:—

The Marquis of Kildare presented a MS. copy of the "Book of Postings of the Forfeited Estates in Ireland, A.D. 1701."

Dr. W. D. Moore presented his Translation of Professor Donders' work "On the Constituents of Food."

The thanks of the Academy were returned to the donors.

The Academy adjourned.

MONDAY, JUNE 11, 1866.

Sir W. R. W. Wilde, M. D., Vice-President, in the Chair.

The following gentlemen were elected members of the Academy:— John A. Baker, Esq.; Edward H. Bennett, M. D.; Francis R. Cruise, M.D.; Thomas Galwey, Esq.; Thomas Maxwell Hutton, Esq.; Rev. John O'Rourke; and Alexander Thom, Esq.

Dr. Thomas Hayden read a paper "On the Physiology of Protrusion of the Tongue, and its Deviation to the Affected Side in Unilateral Paralysis."

Mr. Eugene A. Conwell read the following paper:—

Has the Lia Fail on Tara Hill been Inscribed?

So much has already been written about the obelisk on Tara Hill, but more particularly by the late lamented Dr. Petrie, to prove that it is the veritable Lia Fail, or Stone of Destiny, on which the Irish kings were formerly crowned, that it is with a certain amount of well-felt diffidence I venture to draw attention to this stone in a new light, and to head this communication with the foregoing question.

It is well known that its present position in the great oval enclosure of the *Rath na Riogh*, or the King's Chair, is not its original one. During the current century it was removed from an adjoining tumulus, called *Dumha-na-Ngiall*, or the Mound of the Hostages, where it previously lay, and was erected as a headstone to the grave of thirty-seven insurgents who were killed in a skirmish with the military at the battle of Tara in 1798.

On the 18th of last month (May, 1866) I paid a visit to Tara, and made an examination of this stone. It stands five feet over ground; and from subsequent examination, on Saturday last, I found that it was sunk a foot and a half in the earth, the entire height or length of the stone being 6½ feet, and its girth 4 feet 10 inches.* I was at first struck by finding two lines cut into the south-east face of the stone, which overlooks "The Croppies' Grave" (as it is familiarly called), each line being 1½ inch long, about an inch asunder, and cut or furrowed out, in V-shaped fashion, to the depth of about three-eighths of an inch. On the top of the pillar, which is rounded off, can still be traced the remains of four cup-like hollows, in their present appearance rudely dug into the stone. Other portions of the pillar also afford evidences of similar cup-like hollows.

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* The late eminent Dr. Petrie, in his celebrated essay "On the History and Antiquities of Tara Hall," published in the "Transactions of the Royal Irish Academy,"

The stone itself, which is a pillar of very fine-grained granite—a rock not belonging to the locality, and which consequently must have been imported here—appears to me not to have been originally a round pillar, as its present aspect might suggest, but a quadrilateral stone, whose edges have been worn off by attrition and the action of the weather.

On Saturday last (June 9, 1866), I paid another visit to Tara; and having dug round the base to the extremity of this stone, I found that on the same face which contained the two inscribed lines before mentioned, for a foot in height, the surface was quite smooth and flat across the entire face of the stone; and on this portion of it were two lines cut, as seen in the rubbing, and a third line ending in a cup hollow. The fact of this portion of the stone, now sunk in the earth, having been found to be quite smooth, leads me to suppose that the entire surface of the stone was originally the same, and contained characters engraved upon it. On the opposite side of the stone, now its north-west face, and near the bottom, are to be found three other lines, whether or not owing to the action of time, assisted by a natural fracture in the rock, is a point which I trust some one more competent may hereafter clear up.

From the fact of the principal cuttings which I have observed on this stone overlooking immediately "The Croppies' Grave," where it has in recent times found a site, I infer that those who placed it there must have observed, and acted on such evidence, that this face of the stone contained something more of interest than any of the others.

The stone itself, although it may have been originally covered with hieroglyphics, from being of rather a soft and friable nature has in course of time lost those inscribed records, which might have settled the question of its identification as the real *Lia Fail*.

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vol. xviii., p. 161 (1837), writing of the Lia Fail, has fallen into two mistakes regarding this stone—one, as to its material being limestone; and the other, as to its dimensions, which are overstated. His description is:—

"The material of which this monument is composed is a granular limestone, very probably from some primary district; but whether it be Irish or foreign has not been ascertained; it may be remarked, however, that no granular limestone occurs in the vicinity. The stone is at present but six feet above ground, but its real height is said to be twelve feet."

MR. EUGENE A. CONWELL read the following Paper:—

ON AN INSCRIBED CROMLEAC NEAR RATHKENNY, CO. MEATH.

AT page 105 in the late Dr. O'Donovan's manuscript letters, containing information "relative to the antiquities of the county Meath, collected during the progress of the Ordnance Survey in 1836," reference is made to a very remarkable cromleac in these words:—

"Near Rathkenny House are two large stones, which, though described in Name Book, p. 23, as part of a cromleac, are not known, however, by that name among the people. They are sometimes called large stones, and are said to have been thrown from Tara Hill by Fionn Mac Cumhail."

From the fact of the stone which forms the subject of the present notice being about twenty tons in weight, and its distance from the Hill of Tara, in a northerly direction, about eighteen statute miles, the correctness of the above information may be very fairly doubted. This—improbable, nay, impossible as it is—is all that the country people, up to the present day, can tell you respecting the remarkable memento of very remote ages which still exists at Rathkenny.

Seeing mentioned on the Ordnance Map of the district about Rathkenny, which is a village lying four miles N. W. from the town of Slane, what is there marked as a "Druid's Altar," I had the curiosity to visit the place on the 27th February, 1865; and I was astonished to find that the singular and elaborate inscriptions on this cromleac had not attracted previous notice.

On the 11th March following I spent several hours in a fruitless attempt to get a good rubbing of the upper surface of the slab, although I succeeded in taking accurate rubbings of seven circles on the under side, and of seven other circles picked on the opposite face of the single upright stone against which it leans. The circles on the under surface are not on, or about, the middle of the large slab, but nearer to the lower edge of the stone, which rests upon the ground, than to the upper portion of it. In Plate X., fig. 1, their relative positions are shown, the circles being nearly one-twelfth of the actual size.

The single upright stone against which the cromleac slab rests stands about four feet over ground, is four feet broad where it emerges from the ground, tapers slightly as it ascends, and varies from eighteen inches to two feet in thickness. The interior face of this supporting stone presents the appearance of having been picked all over with minute hollows for the purpose of ornamentation; and the seven circles hollowed out on this face are grouped in the manner shown in Plate X., fig. 2, being there represented nearly one-twelfth of their actual size.

The construction of the circles is rude and irregular, formed by lines about half an inch in breadth, and about a quarter of an inch in depth, which appear to have been picked out of the stone with a metallic implement.

In our present state of archæological knowledge it would be almost idle to speculate as to the age of these monuments, or the people by whom they have been erected. By some they are called Celtic, and the people who erected them Celts; while others hold that they have been raised by a people ethnologically different from the Celts—cromleac building and burying being a form of sepulture in all probability practised before the arrival of the Celt, as it has been certainly followed in countries where neither Celt nor any other branch of the Aryan or Indo-European race ever penetrated; for we find such in Syria, and along the northern coast of Africa. The race that erected cromleacs must have been much more widely diffused over the world's surface than the Celtic, and in all probability that race existed in our own country before the Celts.

Le Baron A. de Bonstetten, in his "Essai sur les Dolmens," published at Geneva last year, at pp. 5, 6, 7, &c., enters minutely into the classification and description of the various kinds of existing cromleacs (dolmen being the word adopted on the Continent to signify what in the British Isles we call a cromleac). Unless we suppose the monument near Rathkenny to be a *cromleac in ruins*, we cannot bring it under this most recent and carefully studied classification of such remains.

If we adopt the meaning of the term *cromleac*, which probably has come to us through the Welsh, to be *a leaning stone*, or *inclined stone*, I am disposed to think that this monument near Rathkenny is perfect as it now stands; that it never consisted of more than the two stones; and that this may be a type of monument not hitherto noticed or described. I am the more impressed with this belief, because up to about thirty years ago another slab, popularly remembered as very similar, nearly, but not quite, as large as that just described, and facing in the same direction, existed in an adjoining field, at a point 275 yards south-east from the present one. What mystic characters it may, or may not, have contained inscribed upon it no one now can tell. The man—Christy Downey—still lives, who, in his zeal for agricultural improvement, subjected this stone to the operation of blasting; and its *debris* were afterwards worked up into fences and drains. He states that in the act of blasting "this stone was raised *entire* into the air for about six feet above the surface of the ground, and it then broke into pieces."

There was also a third "big stone," of still smaller dimensions, which he describes as lying quite flat, and about two perches to the east of the one just mentioned as destroyed. From what he saw in the destruction of the first stone he would not undertake to break or to blast this one, though less in size than the other. He therefore dug a deep pit on one side of it; and when in the act of prizing the stone into the pit, he says that "such a whirlwind came about my legs as astonished me; and I saw the effects of the wind on the surface for six or eight perches all round." Under the centre of the stone, he states, "there was a cavity of about the size of a good pot, with black mould in it, and a horseshoe on one side of the cavity, and a broken glass bottle on the other." Both horseshoe and bottle, I presume, found their way there in modern times.

The subject of our present notice was also doomed; but, on the night preceding the day intended for commencing operations upon it, Christy strolled out from his cottage, and, looking towards the scene of his next day's projected labour, saw *a light* in the direction of "the big stone," there being low marshy ground in the neighbourhood immediately beyond. He returned to his home, and came to the wise conclusion, from all that he had seen, that it would be dangerous to interfere further with these "sacred stones." So, after one of these primitive monuments having been blasted, and another buried, to the fortuitous appearance and the lucky intervention of the *ignis fatuus* we are at the present day indebted for the preservation of the singular vestige of our nation's early history which I have feebly endeavoured to lay before the Academy.

Several raths or forts are in the immediate vicinity; and tradition states that there are also several subterranean caves, which I have not had either the time or the opportunity to find out or to investigate.

The Secretary brought up the following recommendation of Council:—

"That the sum of £50 be granted for the purchase of Antiquities, the arrangement and registration of articles in the Museum, and for other matters connected with the department of Antiquities."

The question having been put, it was moved as an amendment, by Professor Haughton, and seconded by Professor Jellett—

"That it be recommended to the Council to omit all the words following the word 'Museum'".

A division being called for, it was found that ten members voted for the amendment, and twenty-three against it; it was therefore declared lost.

The original motion was then put, and carried.

Read—Letters of acknowledgment from Professor Clausius and Mr. Albert Way, on their election as Honorary Members.

The following presentations were made:—

"Limerick, its History and Antiquities, Ecclesiastical, Civil, and Military, from the Earliest Ages," by Maurice Lenihan: from the Author.

"Astronomical and Meteorological Observations made at the Radcliffe Observatory, Oxford, in the Year 1863," Vol. XXIII.: from the Radcliffe Trustees.

"Statistics of the United Kingdom of Great Britain and Ireland; May, 1866:" from Alexander Thom, Esq.

"Cassell's Illustrated History of England," Vols. III. and IV.: from J. Godkin, Esq.

MONDAY, JUNE 25, 1866.

Sir W. R. W. Wilde, M. D., Vice-President, in the Chair.

The following gentlemen were elected members of the Academy:—David R. Edgeworth, Esq., and John O'Hagan, Esq.

Sir W. R. Wilde read the following paper:—

On the Battle of Moytura.

The author brought under the notice of the meeting the first of a series of communications he was about to make to the Academy upon the topography of the Battle-fields of Moytura, and the monuments still standing upon those memorable localities, and which were some of the earliest places referred to in the Irish annals.

He mentioned that there were two battle-fields of this name, one was the northern or the "Moytura of the Fomorians," in the parish of Kilmacatranay, in the county of Sligo, adjoining the north-western end of the county of Roscommon, and extending from Lough Arrow to the strand at Ballysadare; but with which he would not deal on the present occasion. The other, on the southern site, or "Moytura Conga"—of which Sir William exhibited a large map, and pointed out the different localities on it—occupies the western extremity of the great plain at the junction of the counties of Mayo and Galway, extending from the Fairy Hill of Knockmaha, near Tuam, to Benlevi, the first of the mountain range, which, rising from the waters of Loughs Corrib and Mask, gradually ascend and stretch into the Partry, Joyce Country, and Connemara mountains. This was the particular locality to which he proposed to call the attention of the meeting, and said he hoped on a future occasion to bring forward illustrations of the most remarkable of the very ancient monuments which crowd around the picturesque village of Cong, and occupy the northern sloping banks of Lough Corrib, and the eastern borders of Lough Mask. This great plain is nearly sixteen miles long, and the monuments occupy a space of about five miles in breadth at its western end. It was originally called Magh Nia, or Nemeadh, and in some works Magh Itha, before the celebrated battle from which it took its historic name; but at present it goes by the Irish name of Ath Readh, or the unobstructed plain. Sir William said:—

Prior to the date assigned by the Four Masters, A. M. 3303, for the battle of Moytura Conga, the entries in our annals are comparatively few, meagre, and of very doubtful chronology, and consist chiefly of notices of cosmical phenomena, colonizations, pestilences, the clearing of the plains, the erection of forts, raths, and cashels, and the battle of Sleamhnai, Maighe Ithe, on the banks of Lough Swilly, in the county of Donegal, between the Fomorians, the possessors of the island at that period, and the newly arrived forces of Parthalon, the so-called Oriental or Grecian leader. The Firbolgs, or Belgæ, so called from their assumed Belgic origin, next occupied the country, and established a Kingly Pentarchy.

When the Tuatha De Dannan, who were a Scandinavian and decidedly a superior race, and who undoubtedly possessed a knowledge of metal, established themselves in the north-east of Ireland, they demanded a division of the kingdom from the Firbolgs; and a meeting took place between their respective ambassadors upon Magh Rein, on the shores of Lough Allen, near Slieve-an-Icrin, in the county of Leitrim; and upon the latter refusing to accede to this modest request, the Tuatha De Danans marched westward, and, according to our histories, occupied the plains of Southern Moytura; and Nuadha, their king, with his staff, took up his position on the heights of Benlevi, from which a view can be obtained of the plains beneath to an immense extent, and a secure retreat preserved towards the fastnesses in their rere.

The Firbolgs, under Eochy Mac Erc, their king, marched from Tara to the eastern end of the plain of Nia, where it rises into the picturesque hill of Knockma, now known as Castle Hacket, and where, according to the legends of the land, the Fairy King Finvarra (the Oberon of Irish Sylvan mythology) holds his court. From thence may be obtained one of the grandest views in Ireland. To the east, the great plain stretches beneath and around, from the hill of Knockroe to the towers of Athenry, or City of the Ford of the Kings, and includes the Tuam of St. Jarlath, the round tower of St. Benan, the beautiful abbey of Knockmoy, and the ruined keeps of the De Burgos—to the south, the ships riding in the Bay of Galway can be discerned in a clear day, and the Slievebloom and Clare mountains; and to the west the blue island-studded waters of Lough Corrib, and in the far western background the Connemara Alps, stretching from Lecanvre and Sheanapholia, with their clear-cut edges, and their sides momentarily varying in tints from the marvellous atmospheric effects of that region, round to the lofty peak of Croagh Patrick, and the bulky form of Nephin, and even some of the Achill mountains skirting Clew Bay, are all within view. Certainly, if the son of Erc had an eye for the picturesque, or a soul for poetry, his patriotism should have warmed when he viewed the fair scene which was sought to be wrested from him by the invader.

On the summit of Knockma an immense cairn of small stones has been erected over the remains of the female Cœsair, the first of that great western chain of similar monuments that stretch from thence to the valley of Maam, and finally abut upon the shores of the Atlantic near Renvyle. Around this cairn, in the month of May, the ground is literally blue with the flowers of the *Gentiana verna*. The battle is said to have been commenced on the 11th of June; it lasted four days, and ended in the defeat of the Firbolgs, and the death of their king, the pillar stone of whose son is probably the long stone of the Neale. Nuada, the Dannan king, lost his hand; and from the circumstances stated in the Bardic legends of an artificial arm having been supplied, he is ever after mentioned in history as "Nuad of the Silver Hand." Whether Belor of the basilisk eye, another well-known character in our early tales, was at the battle of Southern Moytura is doubtful; but all the legends respecting the petrifying qualities of his eye, and even where he stood, &c., at the time of the engagement, are still related of the "Fothach Rua," or great red giant. Fintan, the sage; Edena, the poet-prophetess; Dianchecht, the physician; Credne, the artificer; Gobnen, the smith; and all the Druid celebrities of early historic romance are said to have been at this battle. The site of the fiercest combat, and that which is still called *Cath na Bunnen*, or the Valley of "The Battle of the Butts," because it is said that, the weapons of the belligerents having been injured, they fought with the butts, like the "Faigh-a-Ballaghs" of later days, is still pointed out.

Several years afterwards the second battle, on the Northern Moytura, was fought; and after it, as well as on the occasion of the previous defeat, the Belgæ, or Firbolgs, fled for security westwards, and entrenched themselves in those stupendous fastnesses of Arran, in Galway Bay—so that even then we see that the destiny of the Celt was Westward. But that they did not all go is manifest from the very marked characteristics of the two races, the dark and the fair, still remaining in the West.

These few particulars and the foregoing brief sketch are worth mentioning, inasmuch as heretofore some misconception has occurred, and some erroneous statements have been put forward by writers who have jumbled up the two battles of Moytura, although many years took place between them, and the intervening space from the Sligo to the Mayo locality is about fifty miles. Between the western slopes of Knockma, in the barony of Dunmore, to Shrule, and through the rich pastures of the barony of Kilmaine, the plain is studded with forts and circular raths, showing the early cultivation and comparatively dense population of that district. As, however, we advance westward through the barony of Kilmaine, over the great plain where the limestone crops out above the surface, in many places to the extent of several acres, the grass-grown circles are replaced by immense cairns, artificially constructed caves, circles of standing stones, many of gigantic size, monoliths or pillar stones, and great duns, cashels or stone forts, resembling some of those in Kerry and the Western Islands of Arran. All these accumulate, and finally culminate into a narrow space of about four square miles, the eastern line of which would run from the village of Cross to the Neale, and thence by Ballinrobe, to the western shores of Lough Mask, and the narrow neck of land between it and Lough Corrib to the waterport of Cong, where the wealth, taste, and liberality of our distinguished church restorer, Mr. Guinness, have done so much to beautify the landscape, to benefit the people, and to restore the crumbling columns of that Abbey, wherein was preserved the greatest artistic, as well as the most historic memorial of piety and skill to be found in north-western Europe—the Cross of Cong that now adorns our Museum.

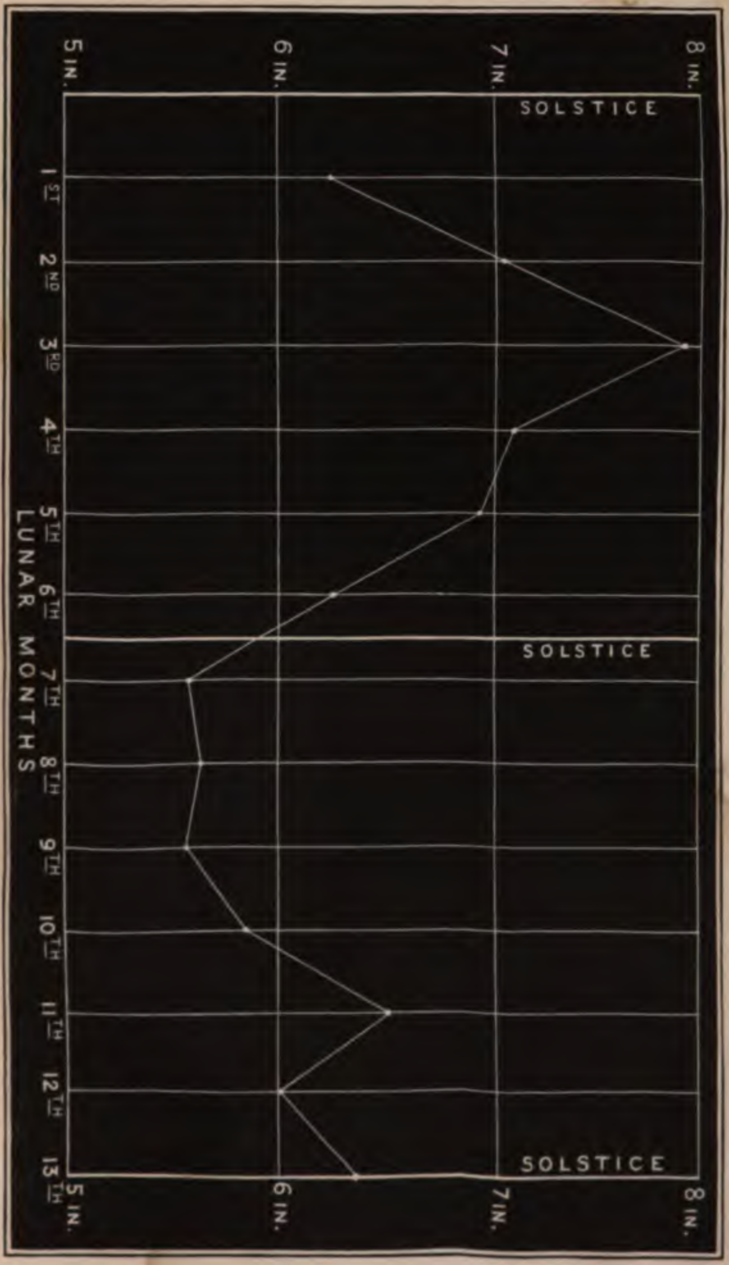
About forty years ago, our great Petrie, in company with our bard and artist, Samuel Lover, visited this locality, and greatly regretted the obliteration of many of the monuments which he expected to find there. In 1838, O'Donovan, then an officer in the Ordnance Survey, under our distinguished Academician, Sir Thomas Larcom—who for upwards of forty years has been more Irish and more useful than many of the Irish themselves—went over this locality; but his observations thereon were not as full as might be wished. O'Donovan, however, has left behind him what is even more valuable than a mere enumeration and identification of forts and cairns, in a translation, executed with that facility of diction in which he excelled, of one of those metrical histories which abound in our early literature, and which, although defective in the romance of the epic, is more truthful in its history and topography than the "Tain Bo Cuilne;" but, like it, it was probably derived from varied and earlier sources than the times of the transcriber or collector.

Having spent much of my youth in this memorable locality, where my ancestors sheltered the ecclesiastics who fled with the Palladium of the West, to which I have already referred, and having the honour to own a small bit of this battle-field myself, I have during my occasional visits to the country thoroughly investigated all these monuments on Southern Moytura; and, as an instance of what may be done by local investigation, I may mention that within the space of a single sheet of the Ordnance Map I was enabled to point out no less than twelve most interesting monuments previously unnoticed, consisting of forts, raths, stone circles, caves, lisses, and cashels, &c., all of which will be marked upon the new edition of that great work; and upon a future occasion I hope to be able to bring these and others in detail under the notice of the Academy. I may also mention that, through the kindness of my friend George Crampton, Esq., I have been supplied with a map and measurements of Caher-Mac Turk, the Dannan fort at Nympsfield, which was removed at the time of the building of the glebe house there, nearly fifty years ago: so that upon the whole we can even now enter upon the consideration of the battle-field of Southern Moytura with a fair prospect of success. The legendary lore and traditional accounts respecting this and other battle-fields, and the events for which they were celebrated, have now almost ceased to exist. The locality can, however, be recognised by the topographer, and the monuments thereon identified by the antiquary, while much of the old *sagas* may be culled from the popular superstitions of the district, or gleaned from the tale, surrounded as it is by all its incongruities, of the old Sennachie, whose language one understands, and whose feelings one reverences. Yet, although this traditionary and popular remembrance of the battle-field affords no more information than can be gleaned from similar sources respecting the raths of Tara, the monuments on the banks of the Boyne, the cahers of Arran, or the Round Towers, and several of the primitive churches, and even the Norman castles throughout the country, there are names attaching to this locality which serve to guide the painstaking and skilled inquirer; and the ancient Irish annals, and some manuscripts believed to be derived from very early sources, afford sufficient materials for attempting now, in the middle of the nineteenth century, an essay on a battle-field referred by our annalists to a period before the Christian era.

To popularize Irish history, and familiarize our youth with incidents such as the foregoing, will tend to the mental culture of the rising generation, and the preservation of our national monuments; but until some Scott, or some one endowed with even a fragment of his genius; and combining, as he did, the knowledge of the antiquarian scholar, the deep research of the historian, the gifted tongue and feeling heart of the poet, the subtle wit of the humorist, the dramatic powers of the novelist, the knowledge of the popular superstitions and modes of thought of his countrymen, together with that rarest of all powers, the faculty of fusing fiction and fact, so as to weave a romance common to humanity with the historic incidents and characters of the past, we shall never have an opportunity, notwithstanding our much greater materials, for vieing with the literature of Scotland.

Sir William R. W. Wilde exhibited plans of some of the subterranean chambers he had discovered, and quoted several of the early authors on the subject of Moytura. He also said he intended dividing his communications on Moytura into three portions—a general sketch of the battle-field, an historic account of the engagement, and a detailed description of the monuments still existing thereon.

Sir William R. W. Wilde brought forward, and made some remarks upon, his paper on the Plunket MS., descriptive of the civil wars in Ireland, and styled "A Light to the Blind," which he had read to the Academy on the 27th June, 1859.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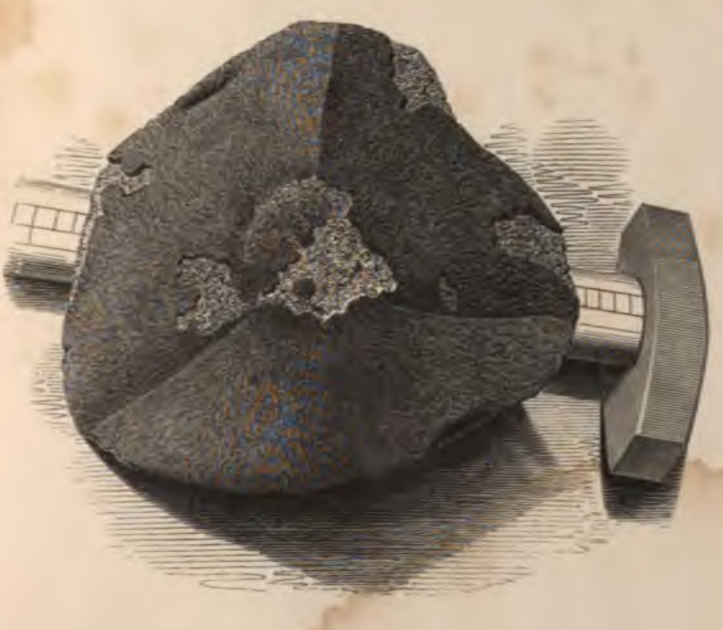
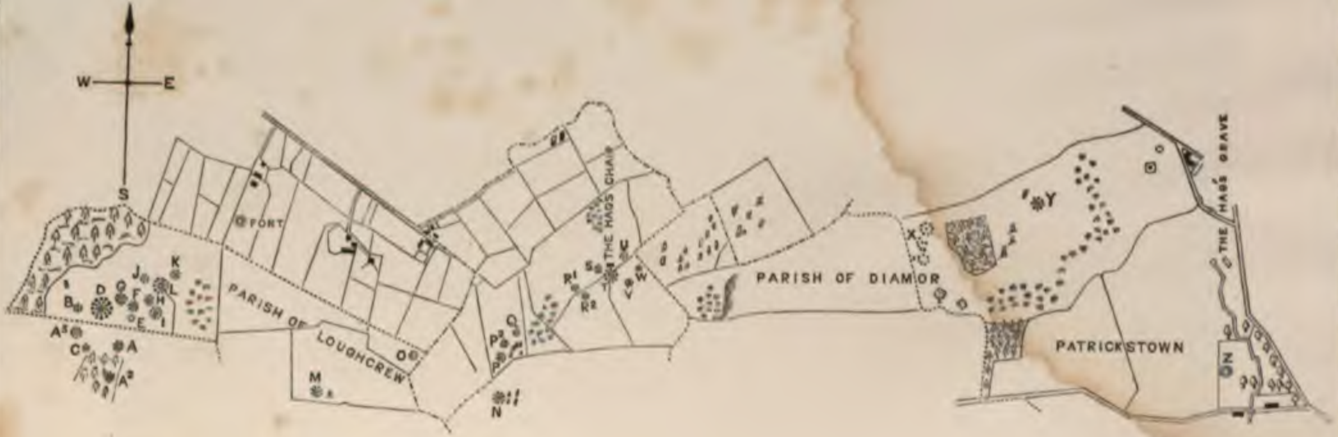
LUNAR MONTHS

DUNDRUM METEORITE.



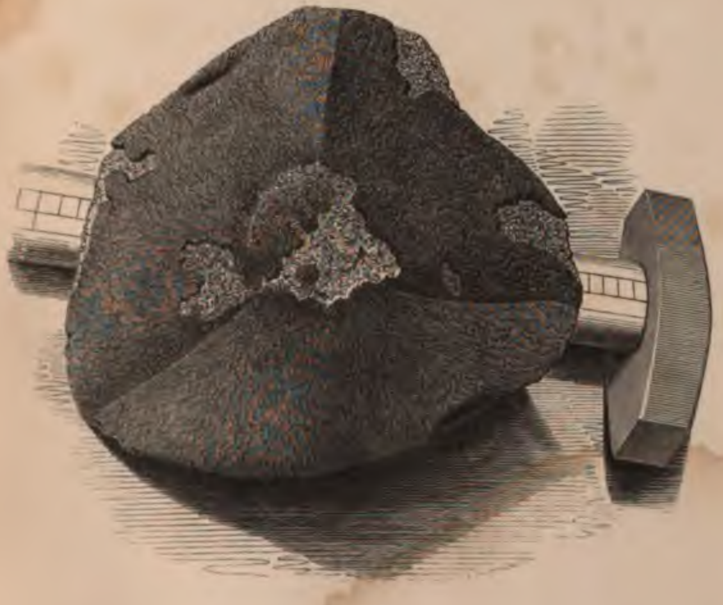
End View of the DUNDRUM METEORITE (12th August, 1865), showing the straight lines of the Crust, along the edges of Pyramid.



MAP OF THE ANCIENT SEPULCHRAL CAIRNS ON THE LOUGHCREW HILLS, OLDCASTLE, CO. MEATH, IRELAND.

Scale:—2·64 inches to a Statute Mile.

DUNDRUM METEORITE.



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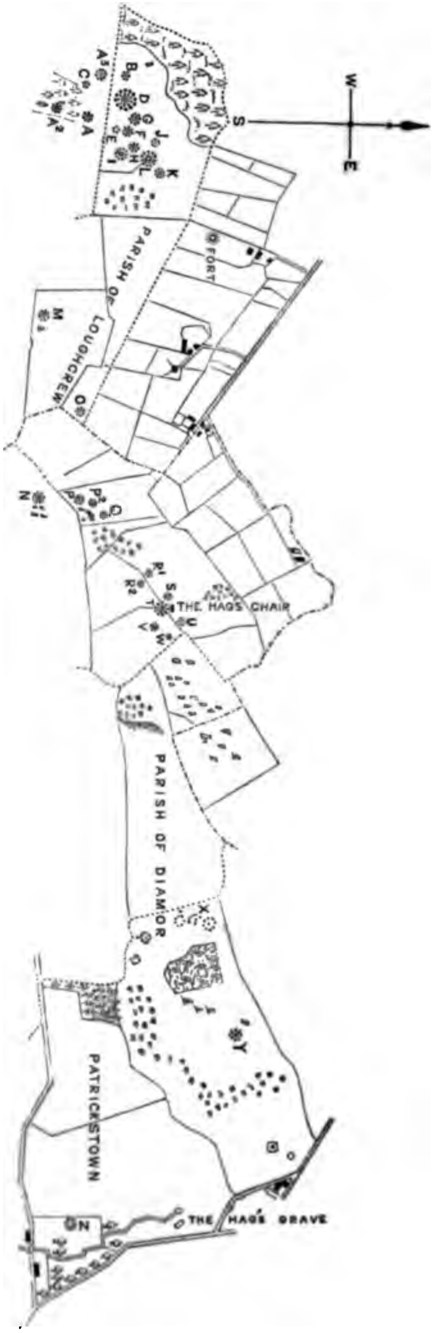
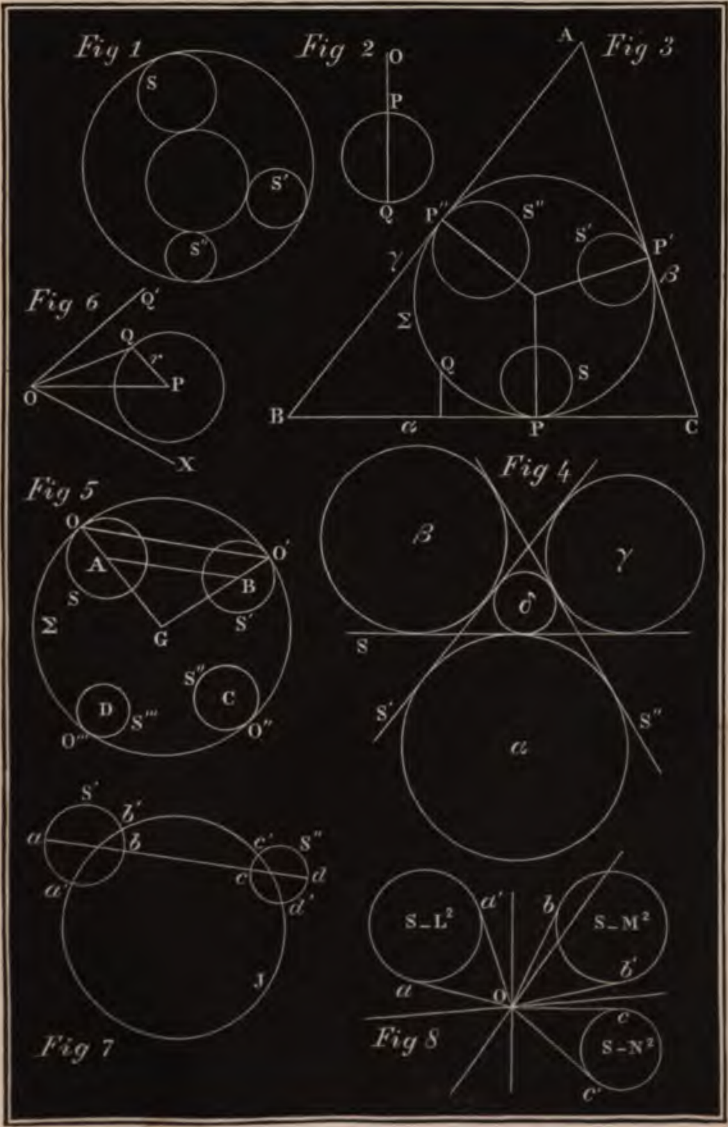


MAP OF THE ANCIENT SEPULCHRAL CAIRNS ON THE LOUGHCREW HILLS, OLDCASTLE, CO. MEATH, IRELAND.

Scale:—2·64 inches to a Statute Mile.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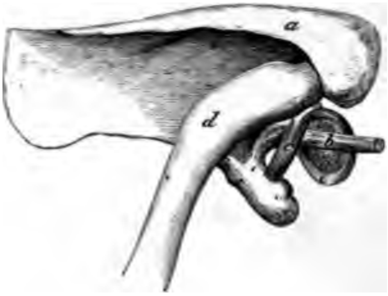
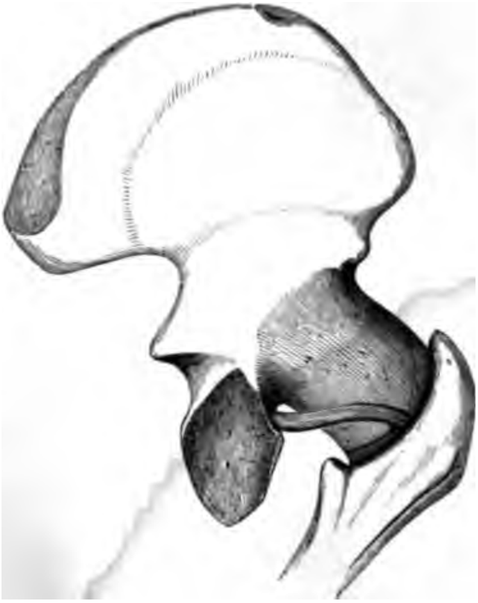


Fig. 1.



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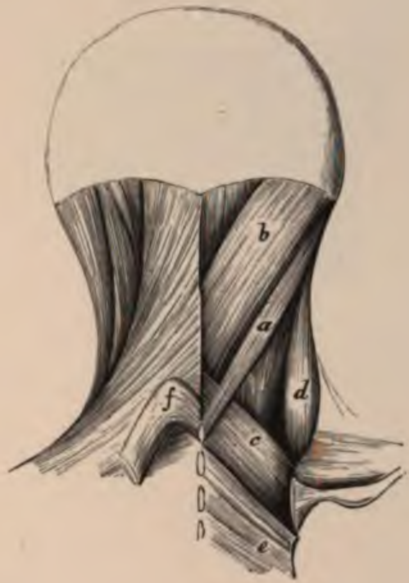

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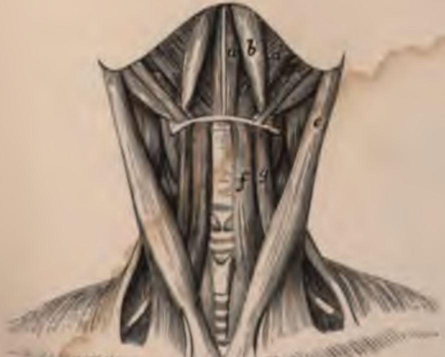

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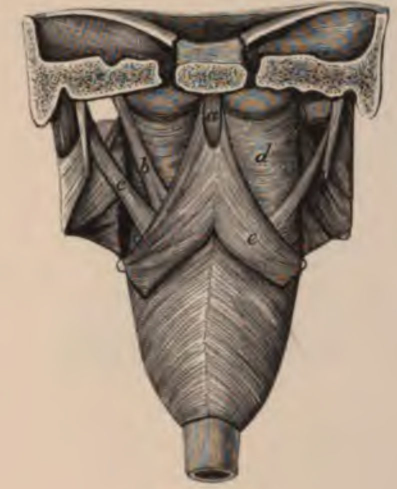

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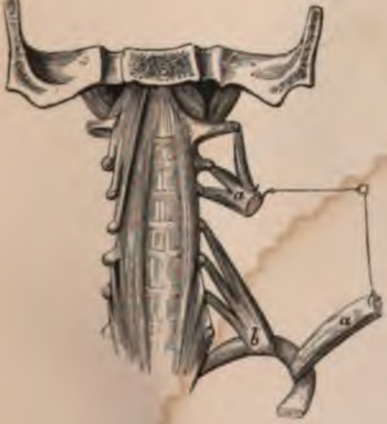

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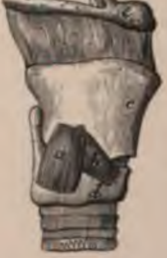

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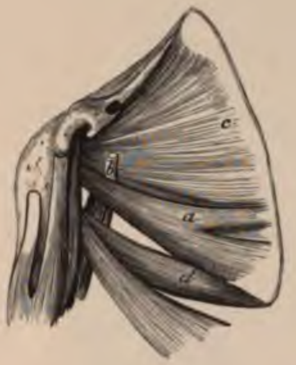

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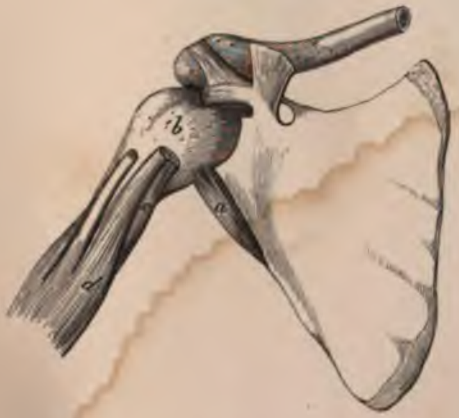

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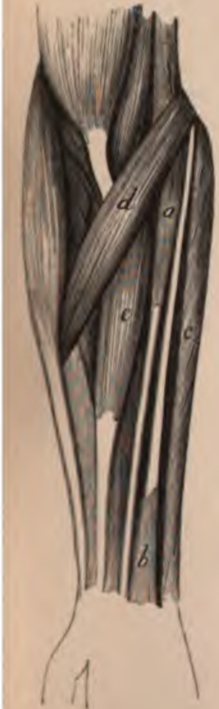

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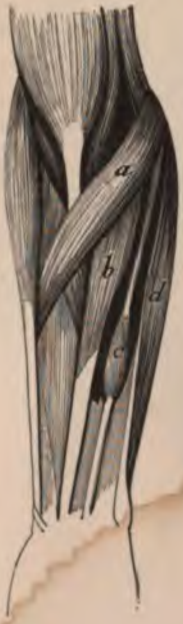

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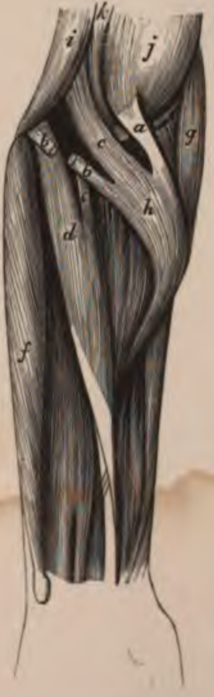

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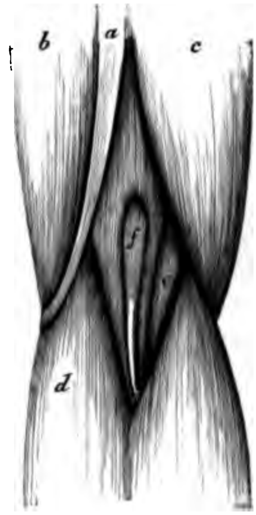
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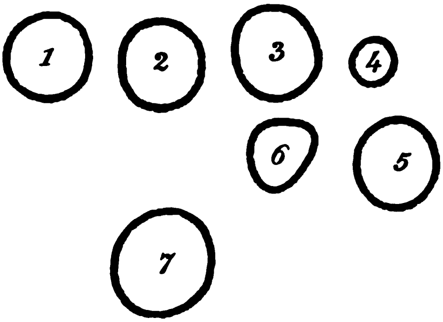

No. 1	measures	6½	inches in diameter from outside	to outside of the circular line.
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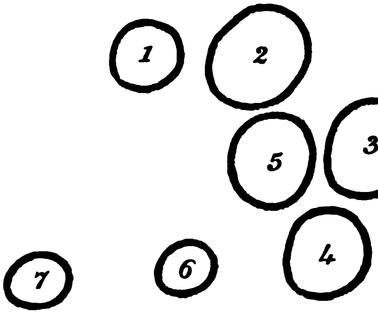
, 3	do.	6½	do.	do.
,, 4	do.	4½	do.	do.
,, 5	do.	6½	do.	do,
,, 6	do.	4½	do.	do.
	do.	9	do.	do.

Fig. 2.



No. 1	measures	5½	inches in diameter from outside	to outside of the circular lines.
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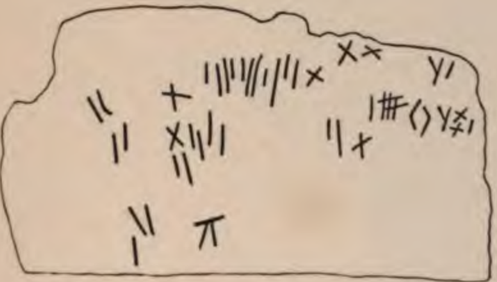
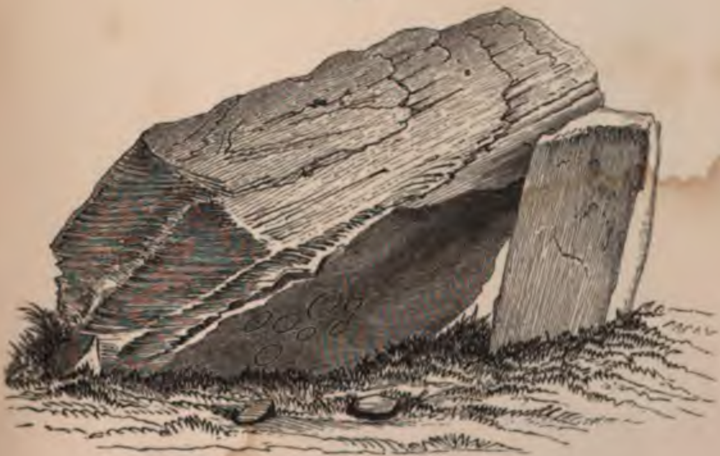
Fig. 3.



Characters on an Inscribed Cromleac, near Macroom, County Cork.

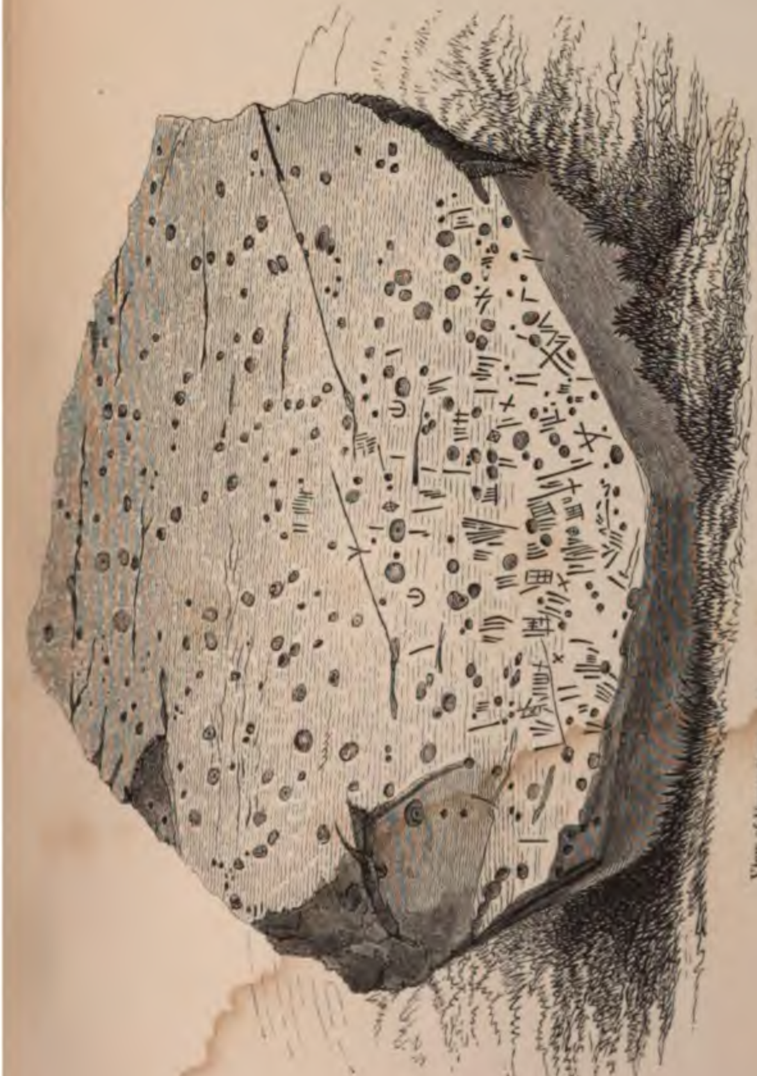
Fig. 4.



Cromleac near Rathkenny House, County Meath.

[View—looking East.]

Fig. 5.



View of Upper Surface of Inscribed Cromleac near Rathkenny House, County Meath.

APPENDIX.

No. I.

ACCOUNT

OF

THE ROYAL IRISH ACADEMY,

FROM 1st APRIL, 1863, TO 31st MARCH, 1864.

THE CHARGE.

			£ s. d.	£ s. d.
To balance in favour of the Public on the 1st April, 1863 (see Vol. VIII., App. No. II., p. xx.),			.....	79 11 3
PARLIAMENTARY GRANT,			.....	500 0 0
CUNNINGHAM FUND, INTEREST, 3 PER CENTS.:—				
Half-year's Interest on £1792 1*s.* 8*d.*	£26 17 8			
Deduct Income Tax,	1 0 2	25 17 6		
Half-year's Interest on £1792 1*s.* 8*d.*,	£26 17 8			
Deduct Income Tax,	0 15 8	26 2 0		
Total Cunningham Fund, Interest,			51 19 6	
ACADEMY 3 PER CENT. CONSOLS:—				
Half-year's Interest on £1159 4*s.* 1*d.*	17 7 9			
Deduct Income Tax,	0 10 1	16 17 8		
Total Academy Stock, Interest,			16 17 8	
Total Interest on Stocks,			.....	68 17 2
CATALOGUES SOLD, PART I.:—				
In April, 1863, 2 copies, 8*s.*; September, 1 copy, 4*s.*; December, 1 copy, 4*s.*; January, 1864, 1 copy, 4*s.*; March, 2 copies, 8*s.*,			1 8 0	
Forward,			1 8 0	648 8 5

	£ s. d.	£ s. d.
Brought forward,	. . . . .	1132 6 7
TRANSACTIONS SOLD :—		
Hodges, Smith, & Co., to March 16, 1864, ...	3 16 11	
M'Gee, W., Vol. XXII., Part III., ...	0 7 6	
Williams and Norgate, to March 16, 1864, ...	8 13 0	
Total Transactions sold, ...	. . . . .	12 17 5
PROCEEDINGS SOLD :—		
Armagh Public Library, binding Proceedings, . . .	0 1 3	
Dixon, Rev. R. V., ditto, . . .	0 1 0	
Kelly, D. H., Esq., ditto, . . .	0 1 0	
Mac Carthy, D. F., Esq., ditto, . . .	0 1 0	
Meehan, Rev. C. P., binding Vols. III., IV., V., VI., and VII., ...	0 5 0	
O'Daly, J., binding Vol. VII., ...	0 1 0	
O'Daly, J., 1 Part Proceedings, ...	0 2 6	
Reeves, Rev. W., D. D., binding Proceedings, . . .	0 1 3	
Smith, Aquilla, M. D., ditto, . . .	0 1 3	
Total Proceedings sold, ...	. . . . .	0 15 3
TOTAL AMOUNT OF CHARGE, ...	. . . . .	1145 19 3

THE DISCHARGE.

ANTIQUITIES BOUGHT, MUSEUM, &c. :—	£ s. d.	£ s. d.	£ s. d.
Dorey, M., Irish coin of Elizabeth, ...	0 1 0		
Doyle, T., ancient brass weight, ...	0 0 6		
Enniskillen, Earl of, for P. Brady, three wooden articles found in a bog near Ballinamallard, ...	0 13 0		
Gann, E., two antique hatchets, ...	0 5 0		
Geoghegan, M., five coins, ...	0 1 0		
Hagerty, E., halfpenny of William and Mary,	0 0 6		
Jones, J., silver coins from Armagh, ...	1 0 3		
Marsh, S., brass figure, ...	0 1 0		
Martin, Rev. T., 10 Saxon and Cufic coins, from Sagga, ...	3 17 6		
Mason, T., silver ornament, ...	0 2 6		
Mulleny, A., antiquities, from Ballina, . .	1 5 0		
O'Brien, B., brass candlestick, found at New Barns, Rowlestown Parish, Co. Dublin, . .	0 6 0		
Ryan, F., antiquities found near Arbane, . .	1 10 0		
Wakeman, W. F., four bronze articles from Co. Galway, ...	0 12 0		
Wilde, Sir W. R., model of shrine of St. Manchan, ...	5 10 0		
Wilde, Sir W. R., antiquities, ...	0 7 6		
Total cost of Antiquities bought, ...		15 12 9	
Forward, . . .		15 12 9	[illegible]

	£	s.	d.	£	s.	d.	£	s.	d.
Brought forward,	. . . .			15	12	9	00	0	0
Smyth, B., van-hire for moving antiquities,	0	10	0						
Dublin and Drogheda Railway, carriage of antiquities,	0	4	1						
Midland Great Western Railway, do.,	0	3	9						
Total cost of carriage of Antiquities,	. . . .			0	17	10			
Kelly, A., drawing antiquities,	0	6	8						
„ gilding plaster casts,	0	5	0						
Total cost of drawing and modelling Antiquities,	. . . .			0	11	8			
Total Antiquities bought, Museum, &c.,	. . . .			. . . .			17	2	3
BOOKS, PRINTING, AND STATIONERY:—									
Barthes and Lowell, books,	5	18	6						
Connolly, T., books,	3	18	6						
Hodges, Smith, and Co., books and periodicals,	21	1	6						
Jones, J. F., books,	5	19	0						
Kelly, W. B., books,	2	13	0						
O'Daly, J., books,	2	0	0						
Thom, A., six copies of Treasury Report on Royal Dublin Society,	0	4	0						
Williams and Norgate, books,	1	2	9						
Total Books, Periodicals, &c., bought,	. . . .			42	17	3			
Camden Society, 1862-1863,	2	0	0						
Palæontographical Society, 1859-1863	5	5	0						
Ray Society, 1862-1863,	2	2	0						
Total Subscriptions paid,	. . . .			9	7	0			
Rainsford, P., labelling books in Library,	2	0	0						
Total cost of arrangement of Library,	. . . .			2	0	0			
Barthes and Lowell, charges on books,	0	16	6						
British and Irish Steam Packet Co., do.,	0	4	7						
City of Dublin Steam Ship Co., do.,	0	1	6						
Dublin and Liverpool Screw Ship Co., do.,	0	3	0						
Fannin and Co., do.,	0	0	6						
General Parcel Office, do.	0	5	0						
Hayes, M. A., do.,	0	7	6						
Henshelwood and Co., do.,	0	3	6						
Lambert, T., do.,	0	1	6						
London and Dublin Steam S. Co., do.,	0	4	0						
London N. W. Railway Co., do.,	0	4	0						
Manchester and London Railway Co., do.,	0	4	6						
Marcus' Parcel Express, do.,	0	1	6						
Mason, G., do.,	0	4	6						
Nolan, J., do.,	0	6	4						
Palgrave and Co., do.,	0	7	2						
Williams and Norgate, do.,	4	4	3						
Total Freight, Duty, and Charges on Books,	. . . .			7	19	10			
Forward,	. . . .			62	4	1	17	2	3

	£	s.	d.	£	s.	d.	£	s.	d.
Brought forward,				62	4	1	17	2	3
Cooke, H., letter signed by Duke Schonberg,	0	15	0						
Total cost of Manuscripts bought,				0	15	0			
O'Neill, T., 25 Vols. Transactions, R. I. A.,	6	5	0						
Total cost of Transactions, R. I. A., bought,				6	5	0			
MISCELLANEOUS BINDING :—									
Caldwell, M., binding books in Library to March 16th, 1864,	32	14	0						
Total cost of Miscellaneous binding,				32	14	0			
Total Expenditure on Library for Books, Carriage, Binding, &c.,				101	18	1			
MISCELLANEOUS PRINTING :—									
Gill, M. H., printing circulars, notes, &c., from March 16, 1863, to March 31, 1864,	19	13	8						
Total Miscellaneous Printing,				19	13	8			
PROCEEDINGS, PRINTING AND BINDING :—									
Gill, M. H., printing to March 16, 1864,	101	6	2						
Hanlon, George A., woodcuts,	2	5	0						
Mowat, J., binding to 16th March,	2	6	3						
Oldham, W., woodcuts,	21	7	6						
Total Printing, &c., Proceedings,				127	4	11			
TRANSACTIONS, PRINTING AND BINDING :—									
Caldwell, M., binding,	2	11	0						
Gill, M. H., printing, to March 16, 1864,	91	14	5						
Mowat, J., binding,	0	11	9						
Oldham, W., woodcuts for Mr. Stoney's paper									

	£ s. d.	£ s. d.	£ s. d.
Brought forward,	. . . .	10 1 1	385 14 7
CATALOGUE OF MUSEUM (PART III.):—			
Oldham, W., engraving gold torques, . .	0 15 0		
Pilkington, F., binding, ...	4 15 8		
Expended on Part III. of Catalogue, .	. . . .	5 10 8	
CATALOGUE OF MUSEUM (PART IV.):—			
Oldham, W., woodcuts, ...	1 2 6		
Expended on Part IV. of Catalogue, .	. . . .	1 2 6	
Total expended on Catalogue of Museum, 1863-64, ...	. . . .	. . . .	16 14 3
REPAIRS OF HOUSE:—			
Boylan, S., cleaning windows, ...		2 7 11	
Bray, J., cleaning ashpit, ...		0 18 0	
Kelly, A., cleaning portrait of Sir Isaac Newton, . .		0 10 0	
Kennedy, P., work in library, ...		0 2 6	
Maguire and Sons, ironmongery, &c., ...		2 19 10	
Murphy, J., sweeping chimneys, ...		1 0 0	
O'Brien, M., window blinds, &c., ...		0 5 6	
Swan, M., work in library, ...		0 2 6	
Total Repairs of House, ...		. . . . .	8 6 3
FURNITURE AND REPAIRS:—			
Angeli, L., painting 21 busts, ...		2 0 0	
Boake and Son, sundries, ...		2 4 4	
Dobbyn and Son, repairs of clocks, ...		0 10 0	
Maguire and Son, ironmongery, &c., ...		0 17 7	
Merry, E., polishing tables, ...		2 5 0	
O'Brien, M., window blinds and fittings, ...		0 16 0	
Smyth, B., removing and shaking carpets, ...		1 10 0	
Yeates and Son, repairing barometer, ...		0 13 0	
Total Furniture and Repairs, ...		. . . . .	10 15 11
TAXES AND INSURANCE:—			
National Insurance Company, ...	£10 6 0		
Patriotic do., ...	6 3 6		
		16 9 6	
Parish Cess, Easter, 1863, ...		0 9 4	
Total Taxes and Insurance, ...		. . . . .	16 18 10
COALS, GAS, &c.:—			
Alliance Gas Company, gas, and fittings, ...		26 9 5	
Lambert, Brien, and Co., tapers, candles, &c., . . .		0 10 6	
Smyth, B., 4 tons coal, ...		3 4 0	
Tedcastle and Co., 30 tons coal, ...		22 6 6	
Total Coals, Gas, &c., ...		. . . . .	52 10 5
Forward,		. . . . .	491 0 3

				£	s.	d.	£	s.	d.
Brought forward,				.	.	.	491	0	3
Incidentals:—									
Advertising in "Freeman's Journal,"				0	3	6			
" "Saunders' News-letter,"				0	3	6			
" "Daily Express,"				0	2	6			
" "Irish Times,"				0	3	0			
Bailey, S., impressions of plates of the "Clog Or,"				1	5	0			
Brooke, W., and Sons, aprons for porters,				0	3	4			
Clibborn, E., one year's allowance for incidentals used in cleaning house,				10	0	0			
Flower, M., wire for Indian instruments,				0	1	6			
Johnson, T., paint, &c.,				0	9	9			
Postages, &c., April 1, 1863, to March 31, 1863,				11	11	5			
Smyth, T., hire of carriage to Archbishop Whately's funeral,				0	12	6			
Vernon, Maguire and Co., twine, &c.,				0	19	5			
Total Incidentals,				.	.	.	25	15	5
Salaries, Wages, &c.:—									
Graves, Rev. C., D.D., Treasurer, 1863-64,				21	0	0			
Reeves, Rev. W., D.D., Sec. of Academy, do.,				21	0	0			
Ingram, J. K., LL.D., Sec. of Council, do.,				21	0	0			
Gilbert, J. T., Esq., Librarian, do.,				21	0	0			
Clibborn, E., Esq., Clerk, Assistant-Librarian, Curator of the Museum, &c., 1863-64,				150	0	0			
Dowse, E. W., Accountant, &c.,				46	0	0			
Kelly, A., house-porter, 52 weeks,				39	0	0			
Leigh, S., messenger, 31 weeks,	23	5	0						
Byrne, P., messenger, 21 weeks,	15	15	0						
				39	0	0			
Keefe, A., cleaning house,				10	10	0			
Molloy, Connor, and Co., servants' liveries,				13	15	7			
Wright and Oxley, servants' hats (2 years),				2	10	0			
MacDonnell, M., boots for messenger,				1	0	0			
Walpole and Geoghegan, servants' ties,				0	15	0			

				£ s. d.	£ s. d.
£16 16 0	*Brought forward*, . . .		£15 15 0	51 19 6	903 6 3
42 14 9	Consols,. . . .	39 8 6			
	117 days' Interest,	0 8 3			
	Brokerage, . . .	0 1 3			
			39 18 0		
36 12 3	Consols, . . .	33 6 4			
	73 days' Interest, .	0 4 5			
	Brokerage, . . .	0 1 3			
			33 12 0		
22 18 4	Consols, . . .	20 15 11			
	76 days' Interest, .	0 2 10			
	Brokerage, . . .	0 1 3			
			21 0 0		
	Total Academy Stock bought, ...				
£119 1 4				110 5 0	
	Total Government Stock bought, ...				162 4 6
	TOTAL DISCHARGE, ...				1065 10 9
	Balance in Bank of Ireland, ...			21 8 0	
	„ in Treasurer's hands, ...			59 0 6	
	Total Balance in favour of the public, ℔ this account (31*st March*, 1864), ...				80 8 6
	TOTAL AMOUNT OF CHARGE, . .				1145 19 3

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL IRISH ACADEMY,

AS FURNISHED TO AUDIT OFFICE, FROM 1st APRIL, 1863, TO 31st MARCH, 1864.

Dr.	£ s. d.	Cr.	£ s. d.
To Balance on 1st April, 1863, . . .	79 11 3	By Academy Stock bought, ...	110 5 0
To Parliamentary Grant, ...	500 0 0	By Cunningham Fund, Stock bought,	51 19 6
To Annual Subscriptions, ...	279 6 0	By Coals, Gas, &c., ...	52 10 5
To Entrance Fees, ...	73 10 0	By Furniture and Repairs, ...	10 15 11
To Life Compositions, ...	116 11 0	By Repairs of House, ...	8 6 3
To Interest on Academy Stock, . . .	16 17 8	By Taxes and Insurance, ...	16 18 10
To Interest on Cunningham Fund, .	51 19 6	By Salaries, &c, ...	386 10 7
To Catalogues sold, Part I., ...	1 8 0	By Printing Proceedings, ...	127 4 11
To Catalogues sold, Part II, ...	2 8 9	By Printing Transactions, ...	109 3 2
To Catalogues sold, Part III., ...	10 14 5	By Printing, Miscellaneous, ...	19 13 8
To Transactions sold, ...	12 17 5	By Books bought, ...	52 4 3
To Proceedings sold, ...	0 15 3	By Miscellaneous Binding, ...	32 14 0
		By Manuscripts bought, ...	0 15 0
		By Antiquities bought, ...	16 14 5
		By Catalogue of Museum, ...	16 14 3
		By Stationery, ...	10 12 6
		By Transactions bought, ...	6 5 0
		By Contingencies, ...	36 3 1
		By Balance to next Account, ...	80 8 6
	£1145 19 3		£1145 19 3

BANK OF IRELAND,
April 15, 1864.

I certify that it appears by the Books of the Bank of Ireland, there remained a Balance of £1848 15s. 8d. New Three per Cent. Government Stock, and £1261 9s. 5d. Government Three per Cent. Consols, to the credit of the Account of the Royal Irish Academy, on the 31st day of March, 1864.

J. R. BRISCOE,
Stock Leger Keeper.

ROBERT ROBERTS,
Transfer Officer.

No. II.

ACCOUNT

OF

THE ROYAL IRISH ACADEMY,

FROM 1st APRIL, 1864, TO 31st MARCH, 1865.

THE CHARGE.

	£ s. d.	£ s. d.
To balance in favour of the Public on the 1st April, 1864 (see Vol. IX., App. No. I., p. ix.), ...	. . . . .	80 8 6
PARLIAMENTARY GRANT, ...	. . . . .	500 0 0
CUNNINGHAM FUND, INTEREST, 3 PER CENTS.:—		
Half-year's Interest on £1848 15*s.* 8*d.*. . . . £27 14 7		

	£	s.	d.	£	s.	d.
Brought forward,	. . . .			689	4	6
CATALOGUES SOLD, PART I. :—						
In February, 1865, 1 copy, 4*s.*; March, 5 copies, 18*s.* 9*d.*, ...	1	2	9			
CATALOGUES SOLD, PART II. :—						
In September, 1864, 1 copy, 5*s.*; February, 1864, 1 copy, 5*s.*; March, 1 copy, 4*s.* 9*d.*, ...	0	14	9			
CATALOGUES SOLD, VOL. I. :—						
In April, 1864, 1 copy, 12*s.*; March, 1865, 2 copies, £1 0*s.* 0*d.*, ...	1	12	0			
CATALOGUES SOLD, PART III. :—						
In October, 1864, 1 copy, 3*s.* 4*d.*; February, 1865, 1 copy, 2*s.* 4*d.*; March, 6 copies, 14*s.*, ...	0	18	8			
Total Catalogues sold, ...	. . . . . .			4	8	2
ENTRANCE FEES (£5 5*s.* each):—						
Babington, T. H., Esq.; Beauchamp, R. H., Esq.; Brooke, Sir V., Bart.; Cotton, C. P., Esq.; Dublin, Most Rev. the Lord Archbishop of; Hennessy, W. M., Esq.; Keenan, P. J., Esq.; Lalor, J. J., Esq.; Mac Donnell, A., Esq.; M'Gee, Hon. T. D'A.; Madden, T. M., M. D.; Meehan, Rev. C. P.; Power, A., Esq.,						
Total Entrance Fees, ...	. . . . . .			68	5	0
LIFE COMPOSITIONS:—						
Beauchamp, R. H., Esq., ...	21	0	0			
Hennessy, W. M., Esq., ...	21	0	0			
Keenan, P. J., Esq., ...	21	0	0			
Lalor, J. J., Esq., ...	21	0	0			
Oldham, T. M., LL. D., ...	6	6	0			
Poore, Major Robert, ...	21	0	0			
Total Life Compositions, ...	. . . . . .			111	6	0
ANNUAL SUBSCRIPTIONS (£2 2*s.* each):—						
For 1862:—						
Corrigan, D. J., M. D.; Smith, C., Esq., ...	4	4	0			
For 1863:—						
Abraham, G. W., LL. D.; Corrigan, D. J., M. D.; Field, F., Esq.; Fitzgerald, Lord W.; Gages, A., Esq.; Galbraith, Rev. J. A.; Gibson, Rev. C. B.; Goold,						
Forward,	4	4	0	873	3	8

	£	s.	d.	£	s.	d.
For 1863:— *Brought forward,*	4	4	0	873	3	8
Ven. F.; Leared, A., M. D.; Lentaigne, J., M. D.; Neville, P., Esq.; Ringland, J., M. D.; Stapleton, M. H., M. B.; Stuart de Decies, Right Hon. Lord; Wilson, J., Esq.	31	10	0			
For 1864:—						
Baker, A. W., Esq.; Bevan, P., M. D.; Berwick, Hon. Judge; Brownrigg, Sir H. J., C. B.; Carte, A., M. B.; Cather, T., Esq.; Claridge, J. Esq.; Codd, F., Esq.; Cooke, A., Esq.; Corrigan, D. J., M. D.; Cotton, Ven. H.; Davy, E. W., Esq.; D'Arcy, M. P., Esq.; Deasy, Hon. Baron; De Vesci, Rt. Hon. Viscount; Domvile, Sir C. W., Bart.; Downing, S., LL. D.; Field, F. Esq; Fitzgerald, Lord W.; Fitzgerald, P., Esq.; Fleming, C., M. D.; Galbraith, Rev. J. A.; Gibson, J. Esq.; Goold, Ven. F.; Graves, Rev. J.; Hancock, W. N., LL. D.; Hanlon, C., Esq.; Hardinge, W. H., Esq.; Hartley, R., Esq.; Haughton, Rev. S.; Hayden, T., Esq.; Hudson, A., M. D.; Ingram, J. K., LL. D.; James, Sir J. K., Bart; Joyce, P. W., Esq.; Kennedy, H., M. D.; Killaloe, Rt. Rev. The Lord Bishop of; Law, R., M. D.; Le Fanu, W. R., Esq.; Lentaigne, J., M. D.; Longfield, Rev. G.; Lyons, R. D., M.D.; Mac Carthy, J. J., Esq.; MacDougall, W., Esq.; Madden, R. R., M. D.; Maunsell, D. T. T., M. D.; Neville, P., Esq.; O'Flanagan, J. R., Esq.; Oldham, T. M., LL. D.; Pigot, J. E., Esq.; Purser, J., Esq.; Richardson, T., M. D.; Ringland, J., M. D.; Segrave, O'N., Esq.; Sidney, F. J., LL. D.; Sloane, J. S., Esq.; Staples, Sir T., Bart.; Stapleton, M. H., M. B.;						

	£	s.	d.	£	s.	d.
Brought forward,	0	11	0	1068	9	8
Mayne, Rev. C., ditto, Vols. VII. and VIII.,	0	2	0			
Nicholson, J. A., ditto, Vols. VI., VII., VIII.,	0	3	0			
Sidney, F. J., LL. D., ditto, Vol. VIII.,	0	1	0			
Smith, Aquilla, M. D., ditto, Vol. VIII.,	0	1	0			
Total Proceedings sold,				0	18	0
TRANSACTIONS SOLD :—						
Burnside, Rev. W. S., Vol. XVIII., Part I., and Vol. XXI., Part I.,	0	15	0			
Hodges, Smith, & Co., to March 31, 1865,	1	6	3			
Williams and Norgate, to March 31, 1865,	13	8	0			
Total Transactions sold,				15	9	3
CONTINGENCIES :—						
Executors of the late Beriah Botfield, Esq., M. P., per Messrs. Urwick and Marston, amount of legacy bequeathed by him to the Academy,	29	15	0			
Total Contingencies,				29	15	0
TOTAL AMOUNT OF CHARGE,				1114	11	11

THE DISCHARGE.

	£	s.	d.	£	s.	d.	£	s.	d.
ANTIQUITIES BOUGHT, MUSEUM, &c. :—									
Robinson, Rev. C., bronze celt from Kilglass,	0	2	6						
Walsh, J., ancient ring,	0	10	0						
Egan, C., iron sword from Chapelizod,	0	2	6						
O'Neal, T., two great seals, in wax,	0	2	0						
Fleming, C., ancient brass seal from the Cistercian Abbey, Baltinglass,	1	0	0						
Wilde, Sir W. R., antique wooden shield,	4	5	6						
Reynolds, J., bronze pin from Moyvoir,	0	1	0						
Jones, J. F., a lot of antiquities,	6	19	6						
ditto, ditto,	1	16	0						
Ryan, F., antique candlestick,	0	1	0						
Carroll, T., ten stone celts, and a flint arrowhead,	0	11	0						
Langan, P., bronze beam of scale from Kilmainham,	0	5	0						
O'Daly, J., wooden crucifix,	0	2	6						
M'Cormack, small bronze pin from Annagh, Westmeath,	0	2	6						
Total cost of Antiquities bought,				16	1	0			
Forward,				16	1	0	00	0	0

	£	s.	d.	£	s.	d.	£	s.	d.
Brought forward,	. . . .			16	1	0	60	0	0
Every & Co., gutta percha for casts, . .	0	4	6						
Total cost of modelling Antiquities, . .	. . . .			0	4	6			
Dublin and Drogheda Railway, carriage of antiquities, ...	0	19	7						
[illegible], J., moving antiquities, ...	0	2	6						
K[illegible], J., ditto, ...	0	2	6						
Midland Great Western Railway, carriage of ancient canoe, ...	0	15	4						
K[illegible], W., carriage of canoe from railway,	0	7	6						
Le[illegible], J., moving canoe into Academy House, ...	0	2	0						
Br[illegible], W. G., Esq., carriage of canoe from [illegible] to Mullingar, ...	0	5	0						
Total cost of moving and carriage of Antiquities, ...	. . . .			2	14	5			
Total Antiquities bought, Museum, &c.,	. . . .			. . . .			18	19	11
BOOKS, PRINTING, AND STATIONERY:—									
Barthes and Lowell, books and periodicals,	4	15	0						
Sa[illegible], James, books, ...	11	10	0						
A[illegible], T., books, ...	3	16	6						
Lovell Reeve and Co., "Horae Ferales," .	2	12	6						
Thom, A., Reports on Scientific Institutions, ...	4	2	0						
Russell, Rev. Dr., Papal Letters relating to Ireland, ...	2	0	0						
Hodges, Smith, and Co., books and periodicals, ...	5	12	8						
Ditto, [illegible] periodicals, . .	11	11	0						
O'Daly, J., Stapleton's Irish Catechism, .	2	2	0						
Jones, J. F., books, ...	2	10	0						

	£	s.	d.	£	s.	d.	£	s.	d.
Brought forward,	6	18	7	56	17	8	18	19	11
Pickford and Co., carriage of books,	0	3	0						
Rowe, W., do.,	0	0	10						
Williams and Norgate, duty, &c., on books,	6	13	8						
Zoological Society, carriage of books,	0	3	6						
Total Freight, Duty, and Charges on Books,	. . . . .			13	12	7			
Connolly, T., General Vallancey's Military Survey (Maps),	4	4	0						
Long, J., "Dialogue of the Sages," and "Life of St. Finchua,"	8	0	0						
Total cost of Manuscripts bought,	. . . . .			12	4	0			
Martin J., 10 Parts Proceedings,	0	5	0						
O'Neill, T., 47 Vols. Transactions, R. I. A.,	11	15	0						
Total cost of Transactions, R. I. A., bought,	. . . . .			12	0	0			
MISCELLANEOUS BINDING :—									
Caldwell, M., binding books in Library from April 1st, 1864, to March 31st, 1865,	44	0	1						
Total cost of Miscellaneous binding,	. . . . .			44	0	1			
Total Expenditure on Library for Books, Carriage, Binding, &c.,	. . . . .			138	14	4			
MISCELLANEOUS PRINTING :—									
Gill, M. H., miscellaneous printing from April 1, 1864, to March 31, 1865,	17	12	0						
Total Miscellaneous Printing,	. . . . .			17	12	0			
PROCEEDINGS, PRINTING AND BINDING :—									
Gill, M. H., printing to March 16, 1865,	48	11	0						
Grey, C., woodcuts,	3	0	0						
Hanlon, George A., woodcuts,	13	15	0						
Mowatt, J., binding Vols. IV. and VIII.,	10	2	2						
Oldham, W., woodcuts,	10	0	0						
Ward, M., and Co., woodcuts,	8	15	0						
Total Printing, &c., Proceedings,	. . . . .			94	3	2			
TRANSACTIONS, PRINTING AND BINDING :—									
Gill, M. H., printing, Dr. Reeves's Paper "On Culdees,"	73	15	0						
Hanlon, G. A., woodcuts, the President's paper "On Undescribed Monuments,"	10	0	0						
Total cost of Transactions,	. . . . .			83	15	7			
Forward,	. . . . .			334	5	1	18	19	11

	£ s. d.	£ s. d.	£ s. d.
Brought forward,	. . . .	334 5 1	18 19 11
STATIONERY :—			
Eaton, M., stamps, paper, &c., from April 1, 1864, to March 31, 1865, ...	6 6 11		
Whelan, M., Thom's Directory, 1865, . .	0 16 0		
Total Stationery, &c., ...	. . . .	7 2 11	
TIDAL OBSERVATIONS, PUBLICATION OF :—			
Mettam, J., drawing tidal curves, . . .	20 0 0		
Expended on Publication of Tidal Observations, ...	. . . .	20 0 0	
Total Books, Printing, Stationery, &c., .	. . .	. . . .	361 8 0
REPAIRS OF HOUSE :—			
Boylan, S., cleaning windows, ...		2 0 10	
Bray, J., cleaning ashpit, &c., ...		0 15 0	
Murphy, J., sweeping chimneys, ...		1 2 6	
Total Repairs of House, ...		. . . . .	3 18 4
FURNITURE AND REPAIRS :—			
Clarke, J., cleaning carpets, ...		1 12 0	
Dobbyn and Son, winding clocks, ...		0 10 0	
,, clock for Council Room, ...		4 0 0	
Hughes, W., lamp glasses, ...		0 4 6	
Maguire and Son, ironmongery, &c., ...		2 2 4	
Merry, E., polishing furniture, ...		3 0 0	
Millar and Beatty, matting, &c., ...		3 14 8	
Mooney, W., gas-fitting, &c., ...		15 17 0	
Total Furniture and Repairs, ...		. . . . .	31 0 6
TAXES AND INSURANCE :—			
National Insurance Company, ...	£10 6 0		
Patriotic do., ...	6 3 6		
		16 9 6	
Parish Cess, Easter, 1864, ...		0 9 4	
Total Taxes and Insurance, ...		. . . . .	16 18 10
COALS, GAS, &c. :—			
Alliance Gas Company, gas to March 31, 1865, . . .		25 7 7	
Lambert, Brien, and Co., tapers, candles, &c., ...		0 12 6	
Matthews, J., cooper's chips for lighting fires, ...		0 15 0	
Tedcastle, R., and Co., 24 tons coal, ...		19 19 8	
Total Coals, Gas, &c., ...		. . . . .	46 14 9
Forward,	. . . .	. . . .	479 0 4

				£ s. d.	£ s. d.
	CONTINGENCIES :— *Brought forward*,			. . . . .	479 0 4
	Clibborn, E., one year's allowance for incidentals used in cleaning house,			10 0 0	
	Gerty and Rorke, hire of carriages,			1 19 0	
	Johnson T., chloride of lime,			0 5 0	
	Queen's Institute, transcribing address to Lord Lieutenant,			0 10 0	
	Smyth, B., hire of men,			0 3 0	
	Postages, from April 1, 1864, to March 31, 1865,			7 14 0	
	Total Contingencies,			. . . . .	20 11 0
	SALARIES, WAGES, &c. :—				
	Carson, Rev. J., D. D., Treasurer, 1864-65,			21 0 0	
	Reeves, Rev. W., D. D., Sec. of Academy, do.,			21 0 0	
	Ingram, J. K., LL. D., Sec. of Council, do.,			21 0 0	
	Gilbert, J. T., Esq., Librarian, do.,			21 0 0	
	Clibborn, E., Esq., Clerk, Assistant Librarian, Curator of the Museum, &c., 1864-65,			150 0 0	
	Doyle, E. W., Accountant, &c.,			42 0 0	
	Kelly, A., house porter, 52 weeks,			39 0 0	
	Byrne, B., messenger, 52 weeks,			39 0 0	
	Keeffe, A., cleaning house,			12 9 0	
	Maher, M., servants' liveries,			15 10 0	
	Foley and Croker, buttons for liveries,			0 18 0	
	Allen, R., overcoats for servants,			4 4 0	
	Total Salaries, Wages, &c.,			. . . .	387 1 0
	GOVERNMENT STOCKS BOUGHT ON ACCOUNT OF CUNNINGHAM TRUST FUND :—				
£29 19 8	New 3 per Cents., cost,	£26 16 8			
	10 days' Interest,	0 0 6			
	Brokerage,	0 1 3	26 18 5		
£31 17 7	New 3 per cents., cost,	£27 8 3			
	2 days' interest,	0 0 1			
	Brokerage,	0 1 3	27 9 7		
£61 17 3	*Total Cunningham Trust Fund, Stocks bought*,			54 8 0	
	CONSOLS BOUGHT ON ACADEMY'S LIFE COMPOSITION ACCOUNT :—				
£30 13 4	Consols,	£27 5 10			
	Deduct 22 days' Interest,	0 1 1			
		27 4 9			
	Brokerage,	0 1 3	27 6 0		
46 12 9	Consols,	41 18 4			
	6 days' Interest,	0 0 5			
	Brokerage,	0 1 3	42 0 0		
£77 6 1	*Forward*,		£69 6 0	54 8 0	886 12 4

				£ s. d.	£ s. d.
£77 6 1	*Brought forward,* . . .		£69 6 0	54 8 0	886 12 4
23 10 0	Consols, . . .	20 17 2			
	41 days' Interest,	0 1 7			
	Brokerage, . . .	0 1 3			
			21 0 0		
23 10 0	Consols, . . .	20 15 11			
	74 days' Interest,	0 2 10			
	Brokerage, . . .	0 1 3			
			21 0 0		
6 19 10	Consols, . . .	6 3 11			
	76 days' Interest,	0 0 10			
	Brokerage, . .	0 1 3			
			6 6 0		
£131 5 11	*Total Academy Stock bought,*			117 12 0	
	Total Government Stocks bought, ...			. . . .	172 0 0
	TOTAL DISCHARGE, ...			. . . .	1058 12 4
	Balance in Bank of Ireland, ...			47 0 7	
	,, in Treasurer's hands, ...			8 19 0	
	Total balance in favour of the Public ℘ this account (31*st March*, 1865), ...			. . . .	55 19 7
	TOTAL AMOUNT OF CHARGE, . .			. . . .	1114 11 11

GENERAL ABSTRACT OF THE MONTHLY ACCOUNTS OF THE ROYAL

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